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Fast Reactor Calculational Route for Pu Burning Core Design

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Stuart Hunter*

Abstract

This document provides a description of a calculational route, used in the Reactor Physics Research Section for sensitivity studies and initial design optimization calculations for fast reactor cores. The main purpose in producing this document was to provide a description of and user guides to the calculational methods, in English, as an aid to any future user of the calculational route who is (like the author) handicapped by a lack of literacy in Japanese. The document also provides for all users a compilation of information on the various parts of the calculational route, all in a single reference. In using the calculational route (to model Pu burning reactors) the author identified a number of areas where an improvement in the modelling of the standard calculational route was warranted - the document includes a description of these changes.

The calculational route makes use of several different computer programs. SLAROM calculates nuclear data from compositions, using either homogeneous or heterogeneous models. CITATION and MOSES do reactor burn-up and/or flux diffusion calculations; CITATION is used for 2D (RZ) calculations, whilst MOSES models 3D (hex-Z) geometry. PENCIL and CITDENS are essentially specialized versions of CITATION (PENCIL includes data preparation and other functions). MASSN calculates fuel cycle mass balances. PERKY performs perturbation and associated calculations, both 1'st order and exact perturbations. JOINT and RZOUT3 provide various dataset interface functions, including energy group condensation.

Briefer descriptions of the calculational route are given, followed by a more detailed step-by-step approach to the calculations. This latter includes examples of all JCL and data files, and a description of all the data that a user may have to employ. The document does not give a complete description of the component programs: where options and/or data are not used in any of the calculations they have generally been ignored; similarly, where data is a fixed value a description has not always been provided.

The document includes comments on and explanations of the modelling assumptions in the various calculations. Practical information on the use of the calculational route and the computer systems is also given.

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* PNC International Fellow (20'th April 1995 -)
Reactor Physics Research Section, Advanced Technology Division, O-arai Engineering Center, PNC, Japan

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プルトニウム燃焼炉心設計ための高速炉解析手順解説

スチュアート・ハンター*

要旨

この報告書では、炉心技術開発室において用いられている高速炉心の感度解析や初期炉心設計の最適化に関する解析手順について解説する。この報告書の主目的は、将来、この計算手順を追うことになる日本語に不慣れなユーザーの助けとなるように、英語でこの計算手順について解説することにある。また、その他のすべてのユーザーの助けとなるよう、この報告書には、この計算手順の各部分についての詳細な情報も記述した。著者は、プルトニウム燃焼炉心のモデル化のために、基準となる計算手順のモデル化について改良を行った。――これらの変更点についても、本報告書に記載した。――

この解析手順では、複数のコンピュータプログラムを利用する。 SLAROM コードは、均質、非均質モデルを用いて、燃料組成から実行断面積を計算する。CITATION コード、MOSES コードは炉心の燃焼方程式や中性子拡散方程式を解く。CITATION コードは、2 次元（RZ モデル）体系の計算に対して用い、MOSES コードは、3 次元（Hex-Z モデル）体系計算に用いる。PENCIL コード、CITDENS コードは、CITATION を特殊目的利用のために書き換えたものである。(PENCIL コードは、計算データの準備等の機能を持つ。) MASSN コードは、燃料サイクルの物質収支を計算する。PERKY は、1 次摂動計算や厳密摂動計算を行う。JOINT コードと RZOUT3 コードは、中性子エネルギー縮約の機能と計算コード間のデータ交換の機能を持つ。

解析手順について簡単に述べた後、この解析の流れをステップ毎に詳細に説明する。また、付録にはサンプル JCL とデータファイルを添付し、ユーザーが必要なデータについて説明を行った。なお、この報告書は、それぞれの計算コードについては、完全に解説を行っていない。通常、無視できるオプションや、通常、固定値を用いるデータに関する記述は省いた。

この報告書には、種々の計算で行ったモデル化や仮定についてもコメントや説明を記載した。また、この計算手順やコンピュータシステムを利用する上で必要となる実際的な情報についてもあわせて記載した。

*動燃　大洗工学センター基盤技術開発部　炉心技術開発室　国際特別研究員
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1 Introduction

This note describes the calculational route I have been using, after 2 years experience at PNC, to carry out fuel cycle and associated reactor safety parameter calculations. The calculational route is one appropriate to studies of design variations and (initial) design optimization work.

This document was written with two intentions. First, for my own reference and to help me in delineating certain parts of the route which could benefit from the addition or improvement of automated data handling routines. Secondly, as an aid to anyone following me in performing similar calculations and similarly handicapped by a lack of Japanese reading ability. The route as described has been used for calculations on Pu burning cores[8,9]; it is described in such a way as to aid in its adaptation to different fast reactor types.

The note gives three separate descriptions of the calculational route, in increasing detail. First, Section 2 just gives a brief description, as an introduction. Section 3 gives somewhat more detail, concentrating on identifying the relationships of the data files that are transferred between the various component calculations. For a fully detailed description of the calculations see Section 6; included are example JCL and data files (listed in Appendix VII) with instructions for use. Appendices give yet more information, such as brief program manuals for those programs where full manuals only exist in Japanese.

2 A brief description.

As the title suggests, this section gives the simplest description of the calculational route.

The calculations can be considered as split into 6 blocks, not all of which may be required for any particular assessment:

- Iterative calculation to produce condensed nuclear data
- Basic fuel cycle calculation
- Perturbation calculations
- Rod worth calculations
- Shutdown margin calculations
- 3D burn-up calculation.

2.1 The 6 calculation blocks.

The 'iterative condensation' calculations consist of: PENCIL burn-up calculations and SLAROM-JOINT-CITATION (S-J-C) snapshot calculations. The latter uses the 'full' 70-group JENDL-3.2 nuclear data, from which it condenses a new reduced-group dataset, used in the PENCIL and other calculations. The calculations are continued in turn, until Keff converges.

The 'basic fuel cycle' calculations consist of a PENCIL burn-up calculation with reduced groups, then S-J-C snapshot calculations in 70 groups - the latter for BOC & EOC conditions and also for Doppler & Na void conditions. Finally, there is a MASSN mass balance calculation.

The 'perturbation' calculations use PERKY to calculate neutron lifetime and delayed neutron fraction; it can also be used to calculate the contributions to Na void (by reaction) and to Doppler (by nuclide). It first requires one SLAROM and several CITATION calculations to prepare data of the required form.

'Rod worth' calculations use the 3D model MOSES in steady-state mode. Reduced-group nuclear data are used. Keff values are calculated for a variety of rod positions.

Various factors, in addition to the foregoing rod worth calculations, are needed for 'shutdown margin' calculations. S-J-C calculations with mesh sizes fractionally increased give reactivity factors for core size expansion. The temperature effect on nuclear data can be obtained from either an S-J-C calculation as part of the 'basic fuel cycle', or from a MOSES 'rod worth' calculation; whichever is used must employ nuclear data for cold shutdown temperatures. Material density reactivity coefficients are obtained from a special package based on PERKY; it uses one SLAROM and 2 CITATION calculations to set up required data.

For accurate values of peak pin rating, the PENCIL burn-up calculation has to be repeated using a MOSES '3D burn-up' calculation. Even with a reduced number of energy groups, this calculation takes a long time to run.

2.2 The computer programs.

MOSES & CITATION are diffusion models, allowing both steady state and burn-up calculations. MOSES is a 3D (hex-Z) geometry: it allows a 6-mesh per S/A model, but I am only using it in a 1 mesh per S/A mode, with interpolation of rating (but not number densities) to 6 meshes per S/A (based on the Askew method). CITATION does support 3D calculations, but is only being used in 2D (RZ) geometry here. [As an old code, I guess it is written to use disk storage more than is necessary with modern computers, so large models take a long time (elapsed time much more so than CPU time).]

SLAROM is the cell model, used to adjust the infinite dilution cross-section data of JENDL-3.2 (the basic 70-group data used in all the calculations) to the compositions of the particular model zones. It can model heterogeneous as well as homogeneous cells.

JOINT is a set of editing programs used as steps of batch jobs. It also does such things as condensing the nuclear data to a reduced number of energy groups, and altering nuclear data between different storage formats.

PENCIL is a program which basically comprises running a CITATION burn-up calculation, which models a series of refuelling steps until fuel cycle equilibrium is achieved. What PENCIL also does is to adjust Pu enrichments and then repeat the CITATION calculation, iterating on Pu enrichments until target Keff and rating balances (inner to outer zone peaks) are achieved.

CITDENS is a slightly modified form of CITATION: it is used to repeat the final CITATION calculation from a PENCIL run, producing an output file of number densities at each step throughout the calculation.

MASSN is basically an editing program; it takes the number density data produced by CITDENS and transforms it into information on the mass balances during the fuel cycle.

PERKY does perturbation calculations - both exact and 1'st order - and also does the associated calculations of neutron lifetime and delayed neutron fraction. The special PERKY package to produce density reactivity coefficients is basically a program script for linking a PERKY calculation with a whole series of data files, and incorporating pre- and post-processors and a CITATION calculation.

RZOUT3 is a short editing program, run interactively to

extract number density data for a single snapshot condition from the output file created by CITDENS.

There are various places where a significant amount of hand editing has to be done to transform the output files produced by one calculation into input required by another. I am in the process of trying to automate these, where practicable, see Section 7. (This note is in part being written to help me define the requirements.)

2.3 Some general comments.

In the most recent series of calculations that I undertook, I significantly increased the detail in which things were modelled, compared with both my earlier calculations and with the standard route as described in PNC documentation (PN9520 94-003). Some of these changes were made because earlier results had pointed up weaknesses in the calculations; others were changed because the nature of the study now called for more detailed but less wide ranging calculations. I will try to make clear where there is a reasonable alternative to use more or less detailed calculations, depending on the aims of the particular study being carried out.

Less detailed calculations can model just half core height (with a reflective centre plane), including no rod absorber in the model. This option was used in my earlier calculations (it is part of the standard PNC route); it is fine for parametric survey type work, but introduces systematic biases into any definitive calculations. The route as I describe it here models the full core height and includes absorbers: using the simpler model will require an extra step to produce nuclear data for the 3D MOSES calculations, in order to incorporate data for absorber material.

The standard route used 7-group data for PENCIL/CITDENS burn-up calculations; this introduced significant random uncertainties in Keff (> half a percent). I am now using 18 groups for these burn-up calculations. The effect may well have been largely a consequence of the core designs I am examining (moderator in the core, no breeder zones). If the use of 18-group data makes the PENCIL run times excessive, then it is always possible to run PENCIL twice, first a preliminary calculation with 7-group data, to get Pu enrichments to use as starting values in the definitive PENCIL calculation (with 18 groups). This should minimize the calculation time.

The level of detail in the flux and number density meshes will to some extent depend on the type of core design. The values used were for a breederless core, where edge leakage effects are particularly important, hence the refined core edge meshes.

3 The calculational route - an outline

In the following, I give a more detailed list of the calculations involved in each of the 6 identified blocks, including those input/output files used to connect the various component calculations. Later on I will endeavour to give a full description, including example data and JCL files. The following section is intended to give a view on how the various components fit together.

3.1 Iterative Condensation block

Produces both 7-group and 18-group condensed nuclear data. If the effects of temperature change on nuclear data (part of the shutdown margin calculation) are to be calculated using MOSES rather than using S-J-C [and I recommend that it is, though temperature reactivity values for the 2 methods differ by <0.1%Δk/kk'], then a 3'rd condensed nuclear dataset is produced, in 7 energy groups, but for shutdown temperatures.

The following series of calculations cycles around repeatedly, until there is little change in Keff (either PENCIL or CITATION) between successive calculations. Only on the final iteration does the S-J-C calculation need to produce all 3 condensed nuclear data files.

PENCIL burn-up calculations in 18 groups, (seeks optimum Pu enrichment)

input	18-group nuclear data 'PENCIL data' file 'CITATION data' file 1 (burn-up)
output	temporary file to run CITDENS

CITDENS burn-up calculation (repeats final case from PENCIL)

input	temporary file from PENCIL
output	number density file (multiple entries)

RZOUT3 extracts single entry (BOC) from CITDENS output

Hand Edit — transform RZOUT3 output to 'SLAROM data' format

S-J-C: SLAROM produces effective cross-sections (70 groups); CITATION snapshot calculation in 70 groups; JOINT condenses nuclear data (using flux from CITATION)

input	JENDL-3.2 70 group nuclear data 'SLAROM data' from Hand Edit 'CITATION data' file 2 (snapshot) 'JOINT data' flux extraction file 'JOINT data' condensation file 1 (7 group) 'JOINT data' condensation file 2 (18 group)

'JOINT data' reformatting file 1 (7 group)
'JOINT data' reformatting file 2 (18 group)

output
temporary flux file, 70 groups
PDS format nuclear data, 7 groups
PDS format nuclear data, 18 groups
'micro' nuclear data, 7 groups
'micro' nuclear data, 18 groups

Hand Edit
alter 'SLAROM data' to cold temperatures

S-J-C: as previous case, except is for cold temperatures

input
JENDL-3.2 70 group nuclear data
'SLAROM data' for cold temperatures
'CITATION data' file 2 (snapshot)
'JOINT data' flux extraction file
'JOINT data' condensation file 1 (7 group)
'JOINT data' reformatting file 1 (7 group)

output
temporary flux file, 70 groups
PDS format nuclear data, 7 group, cold
'micro' nuclear data, 7 group, cold

The "'micro' nuclear data, 18 groups" output, is used as the 18 group input file for PENCIL in the next iteration. The original 18 group input file, and the 70 group JENDL-3.2 input, are pre-existing nuclear data files. All other input files have to be created at the start of the calculation, but are invariant between iterations.

Note that whilst on the 1'st iteration the PENCIL calculation may be allowed to find optimum Pu enrichments, on all subsequent iterations the enrichments must be fixed at those used in the first CITDENS calculation.

The output files generally need to be given new names with each iteration, to avoid conflicts.

It is not necessary to go through this process of condensing new nuclear data for every core variant examined: the main indicators of a requirement for new data are if there are any different nuclides present, or if there are large changes in the proportions of those present. An obvious test for whether a new condensation is necessary: use an 18-group nuclear dataset as the starting point in the first iteration, if the 2'nd iteration PENCIL doesn't change Keff much then there is no need to recondense (since you will already have the slightly improved data produced by the 1'st iteration, this approach is only really useful to check one case that is representative of several others).

3.2 Basic Fuel Cycle block

When the above iterative process has converged on final condensed nuclear datasets - or, if a pre-existing condensed dataset is considered to be adequate for the core/fuel cycle variant being modelled - the following series of calculations is performed.

PENCIL burn-up calculations in 18 groups, (seeks optimum Pu enrichment)

input	18-group nuclear data 'PENCIL data' file 'CITATION data' file 1 (burn-up)
output	temporary file to run CITDENS

CITDENS burn-up calculation (repeats final case from PENCIL)

input	temporary file from PENCIL
output	number density file (multiple entries)

MASSN calculation of fuel cycle mass balances

input	number density file from CITDENS

RZOUT3 extracts single entries (both BOC & EOC) from CITDENS number density file

Hand Edit	transform RZOUT3 output to 'SLAROM data' format; 4 or 5 separate files created: BOC, unmodified EOC, unmodified EOC, Na void (0.0 Na number density) EOC, Doppler (fuel temperature +500)
(optional)	BOC, cold shutdown (all temperatures 473K)

! S-J-C: SLAROM produces effective cross-sections (70
! groups); CITATION snapshot calculation in 70 groups;
! JOINT is just the interface between the 2 other
! programs

! input	JENDL-3.2 70 group nuclear data 'SLAROM data' from Hand Edit 'CITATION data' file 2 (snapshot)

An S-J-C calculation is done for each 'SLAROM data' file created by the Hand Edit.

The cold shutdown case is done if the effects on nuclear data of the temperature change are being calculated by CITATION: if MOSES is being used, cold 7-group nuclear data will have been condensed in the relevant 'iterative calculation', so no cold shutdown S-J-C calculation need be done here.

All the data files not created within this block are identical to the equivalent data files in the 'iterative condensation' block. The JENDL-3.2 and 18-group nuclear data files are pre-existing (the 18-group file comes from an 'iterative condensation' calculation). The one PENCIL and two CITATION input files have to be created by hand for the specific reactor and fuel cycle variant.

3.3 **Perturbation block**

SLAROM and CITATION calculations produce flux and PDS format nuclear data for the 'normal' reactor state and for the perturbed states ('Na void' and 'Doppler' conditions), all for EOC. An exact perturbation calculation using the full 70 group nuclear data is required for the Na void worth to be calculated accurately (compared to a difference in Keff from S-J-C). The Doppler perturbation remains accurate with a 1'st order perturbation calculation in 18 energy groups. The standard PNC delayed neutron data is in 18 energy groups, hence the use of 18 groups in the delayed neutron fraction calculation.

RZOUT3 extracts a single entry from number density file

- input: CITDENS n.d. output of 'basic fuel cycle'
- output: number density data for EOC

Hand Edit: transform RZOUT3 output to 'SLAROM data' format, including versions for 'normal', 'Doppler' and 'void' core states

SLAROM produces 70 group effective cross-sections (for 'normal', 'Doppler' and 'void' states)

- input: JENDL-3.2 70 group nuclear data
  'SLAROM data' from Hand Edit
- output: 70 group nuclear data file ('normal', 'Doppler' and 'void')

CITATION, direct and adjoint flux snapshot calculations, for the 'normal' core state and in 70 energy groups, plus associated JOINT condensation to 18 energy groups

- input: 70 group nuclear data from SLAROM
  'CITATION data' file, 70 groups, 'normal'
  'JOINT data', flux extraction file, 'normal'
  'JOINT data', condensation file, 'normal'
- output: temporary flux file (70 groups)
  direct & adjoint flux file, 70 groups, 'normal', (FT34 format)

PDS format nuclear data, 18 groups, 'normal'

CITATION, direct flux snapshot calculation, for the 'void' core state and in 70 groups
input 70 group nuclear data from SLAROM 'CITATION data' file, 'void'
output direct flux file, 70 groups, 'void', (FT34 format)

CITATION, direct and adjoint flux snapshot calculations, for the 'normal' core state and in 18 energy groups
input 18 group 'normal' PDS data - from 70 group 'normal' CITATION calc. 'CITATION data' file, 18 groups, 'normal'
output direct & adjoint flux file, 18 groups, 'normal', (FT34 format)

CITATION, direct flux snapshot calculations, for the 'Doppler' core state and in 70 energy groups, plus associated JOINT condensation to 18 energy groups
input 70 group nuclear data from SLAROM 'CITATION data' file, 70 groups 'Doppler'
'JOINT data', flux extraction file, 'Doppler'
'JOINT data', condensation file, 'Doppler'
output temporary flux file (70 groups)
PDS format nuclear data, 18 groups, 'Doppler'

PERKY prompt neutron lifetime calculation
input 70 group nuclear data from SLAROM
'PERKY data' file (neutron lifetime)
direct & adjoint flux file, 70 groups, 'normal'- from CITATION

PERKY delayed neutron fraction calculation
input PDS data file, 18 group, 'normal' - from CITATION
'PERKY data' file (delayed neutron)
direct & adjoint flux file, 18 groups, 'normal' - from CITATION

PERKY Na void exact perturbation calculation
input 70 group nuclear data from SLAROM
'PERKY data' file (void perturbation)
direct & adjoint flux file, 70 groups, 'normal' - from CITATION
direct flux file, 70 groups, 'void' - from CITATION

PERKY Doppler 1'st order perturbation calculation, by zone

input PDS data file, 18 group, 'normal' - from CITATION
PDS data file, 18 group, 'Doppler' - from CITATION
'PERKY' data file (Doppler, by zone)
direct & adjoint flux file, 18 groups, 'normal' - from CITATION

PERKY Doppler 1'st order perturbation calculation, by isotope
input PDS data file, 18 group, 'normal' - from CITATION
PDS data file, 18 group, 'Doppler' - from CITATION
'PERKY' data file (Doppler, by isotope)
direct & adjoint flux file, 18 group, 'normal' - from CITATION

The calculations of Doppler contributions are not really necessary, now. The original PNC method allowed only a single temperature for the whole fuel cell, so Doppler effect was overestimated by incorporating effects from steel nuclides. I am now using a heterogeneous 2-region cell model for the fuel, with the fuel pellet separate from other materials, and Doppler temperature changes restricted to this fuel region. Therefore, the effect which the 'by nuclide' analysis was there to examine, has been eliminated. Unless you decide you need to do such a calculation, then several of the above steps can be eliminated: the SLAROM calculation need not include materials for the perturbed Doppler condition; the 70-group CITATION calculation and condensation to 18 groups for the Doppler state can be eliminated, as can both PERKY Doppler perturbation calculations.

3.4 Rod Worth block

For a new core/rods configuration, it will be necessary to survey the range of PCR (main rod) and BCR (backup rod) positions, to find the most effective positions for single stuck rods.

Shutdown margin analysis is restricted to assessing the worths of rod groups with a single rod stuck (there is no consideration of faults during or as a result of rod withdrawal for maintenance). As a result just the following rod positions are to be assessed:

PCRs fully out	BCRs fully out	
PCRs 50% in	BCRs fully out	
PCRs fully in	BCRs fully out	1 PCR fully out
PCRs 50% in	BCRs fully in	1 BCR fully out

The calculations are done for BOC conditions (when shutdown margins are most difficult to meet). If the effect of cold shutdown temperatures on nuclear data is being calculated

using MOSES, the second case is repeated but using the nuclear data for the cold temperature.

PDSDUMP, program to read data - in this case fission spectrum - from PDS format files.

input	JCL file contains data PDS format nuclear data file, 18 group from 'iterative convergence'
output	fission spectrum data, 18 groups

RZOUT3 extracts single entry from a number density file

input	CITDENS n.d. output of 'basic fuel cycle'
output	number density data for BOC

Hand Edit	transform RZOUT3 output to 'MOSES data' number density format; condense fission spectrum to 7 groups; use to create 'MOSES data' snapshot file

! MOSES snapshot calculation in 7 groups

!	input	'micro' nuclear data, 7 groups (from 'iterative condensation')
!		'MOSES data' snapshot file from Hand Edit

A MOSES calculation is done for each of the 4/5 rod configurations and temperature conditions described earlier.

The only differences between the 4 'MOSES data' input files is a (simple) re-positioning of rods; the basic dataset does have to be created by hand for each reactor/fuel cycle. The other input files all come from earlier calculation blocks, as noted.

Rod worths are calculated from the difference in Keff values of the appropriate MOSES calculations.

3.5 **Shutdown Margin block**

The effect of cold shutdown temperatures on nuclear data is dealt with in other calculation blocks. Two sets of calculations are dealt with here: reactivity coefficients for changing core size; material density reactivity coefficients.

First the core size reactivity coefficient calculations:

!	Hand Edit	alter radial mesh size (increase 1%)
!	input	'CITATION data' file, snapshot data (file 2) from 'basic fuel cycle'
!	output	'CITATION data' file, +1% radial mesh

```
!     S-J-C: SLAROM produces effective cross-sections (70
!     groups); CITATION snapshot calculation in 70 groups;
!     JOINT is just the interface between the 2 other
!     programs
!          input     JENDL-3.2 70 group nuclear data
!                    'SLAROM data' file, BOC, from 'basic
!                                              fuel cycle'
!                    'CITATION data' file, +1% radial mesh,
!                                           from Hand Edit
```

The above is repeated, but with the +1% change applied to axial rather than radial meshes.

The remainder of this block is the material density reactivity coefficient calculation:

RZOUT3 extracts single entry from a number density file

input	CITDENS n.d. output of 'basic fuel cycle'
output	number density data for BOC

Hand Edit alters RZOUT3 output to 'SLAROM data' format, includes 'Doppler' version of each material zone

SLAROM creates effective cross-sections, in 70 groups

input	JENDL-3.2 70 group nuclear data 'SLAROM data' from Hand Edit
output	70-group nuclear data file ('normal' & 'Doppler')

CITATION calculation for 'normal' core state, plus JOINT condensation to 18 groups

input	70-group nuclear data file from SLAROM 'CITATION data', snapshot file, 'normal' 'JOINT data', flux extraction file 'JOINT data', condensation file 'JOINT data', reformatting file
output	temporary flux file, 70 groups PDS format nuclear data, 18 groups, 'normal' 'micro' nuclear data, 18 groups, 'normal'

Hand Edit, changing zone names from 'normal' to 'Doppler' versions.

Edit Files:	'CITATION data', snapshot file 'JOINT data', condensation file

CITATION calculation for 'Doppler' core state, plus JOINT condensation to 18 groups

input	70-group nuclear data file from SLAROM 'CITATION data', snapshot file ('Doppler' version, from Hand Edit) 'JOINT data', flux extraction file

'JOINT data', condensation file
('Doppler' version, from Hand Edit)
output temporary flux file, 70 groups
PDS format nuclear data, 18 groups, 'Doppler'

PDSDUMP, program to read data - in this case fission spectrum - from PDS format files.
input JCL file contains data
PDS format nuclear data file, 18 group 'normal', from CITATION
output fission spectrum data, 18 groups

PERKY package, including pre- and post- processors, and a CITATION direct and adjoint flux calculation
input CITDENS n.d. output of 'basic fuel cycle'
Temporary file from PENCIL, used in 'basic fuel cycle' CITDENS
'Fission Spectrum data' file, from PDSDUMP output
PDS format nuclear data, 18 groups, from 'normal' CITATION
PDS format nuclear data, 18 groups, from 'Doppler' CITATION
'micro' nuclear data, 18 groups, from 'normal' CITATION
'Delayed neutron data' file
'Nuclide ID data' file
'Material zone data', 2 files
'Post-processor control data', 3 files
output Several temporary files created by the package (delete them)

The SLAROM run has each zone represented twice, with the 2'nd (Doppler) version having a different zone name - only for fuel/breeder zones is there a temperature difference between the 2 versions. The 'CITATION data' file and 'JOINT data' files used in the normal CITATION calculation were copied directly from the 'iterative condensation' block - if that step was omitted, then these files have to be created now for the reactor/fuel cycle under assessment. The data in the PDSDUMP JCL file is reactor design dependent. The 'delayed neutron data' file is a pre-existing (binary) file.

3.6 3D Burn-up Calculation block

The insertions of different rings of PCRs (main rods) can be used to balance the inner:outer peak ratings; also, different BOC & EOC rod insertions can be used to give a suitable Keff (possibly 1.0) in both states (the PNC reactivity target is 1.0048 at EOC, all rods fully out). It is possible to first use CITATION, rather than the slower running MOSES calculations, to find approximate

values for rod insertions.

```
!     S-J-C: essentially a repeat of a 70-group calculation
!     from the 'basic fuel cycle'
!          input     JENDL-3.2 70 group nuclear data
!                    'SLAROM' data from 'basic fuel cycle'
!                    'CITATION' snapshot data file with
                                   modified rod insertions
```

The above calculations are done for both BOC and EOC states; cases are repeated as necessary, with adjustments, to find acceptable rod positions. These can only give approximate rod insertions, because of feedback effects from altering rod insertions during burn-up.

```
!     Hand Edit, to produce 'MOSES data' burn-up file
!          input     'MOSES data' snapshot file, from 'rod
!                                          worth' calculation
!                    Clean core number density data, taken
!                       from 'CITATION' data used in PENCIL
!                    Burn-up modelling information
!          Output    'MOSES data' burn-up file
!
!     MOSES burn-up calculation, basically the same
!     calculation as PENCIL, but in 3D
!          input     'MOSES data' burn-up file from Hand
!                                                      Edit
!                    'micro' nuclear data, 7 groups, from
!                                  'iterative condensation')
```

The above is repeated as necessary, to fine-tune rod insertions (Keff should not be fine-tuned: the 7-group MOSES calculations will introduce a significant Keff error c.f. the 70-group CITATION calculations).

3.7 Additional Calculation block

As was noted earlier, should the 'iterative condensation' and 'basic fuel cycle' blocks be carried out for a half-height core model with no rod absorber present, then an additional calculation block will be necessary to provide absorber nuclear data for any 3D MOSES calculation, whether 'rod worth' or '3D burn-up'. Such a calculation is described here; note that there is no example dataset nor any detailed description in Section 6.

The calculation uses as input the 7-group PDS format nuclear data files created in the final S-J-C calculation of the 'iterative condensation' block; if files need re-creating, then the S-J-C calculation is re-run. To create condensed nuclear data files, in the binary file format used by PENCIL/CITATION and including the previously absent rod absorber material, the S-J-C calculation is repeated, but with certain changes:

The SLAROM calculation includes an extra material - the rod absorber, it is modelled homogeneously (if '3D burn-up' calculations are required, both homogeneous and heterogeneous versions of the rod absorber are modelled).
In CITATION a new material zone is added: a central region, of radius equivalent to 1 S/A, has the material replaced by rod absorber (the homogeneous version).
The JOINT1 step extracts flux data, just as before. Since data is for MOSES, only the 7-group JOINT2 condensation step is required. Only for the rod absorber region is the condensation carried out (twice, if the SLAROM step contained both homogeneous and heterogeneous data), the flux from the new central absorber zone is used for the condensation. Rather than create a new PDS file, the condensed data is added to the pre-existing PDS file.
The MICRO step, transforming PDS format nuclear data to the binary file format used by PENCIL/CITATION, does so for every zone with data now in the PDS file.

The calculation is done twice, for both the normal and cold shutdown temperature conditions.

4 The Computer System.

Batch jobs are run on the Oarai FACOM mainframe computer. There are a number of idiosyncrasies of the FACOM computer system - they can no doubt all be laid at the door of the IBM machines that it copies - which those who have become used to UNIX type systems will have to (re)learn.

The main problems are to do with file storage: not only is the amount of disk space available very restricted (of order a hundred Mb, at best), it is necessary for the user to do a lot of the housekeeping work. Library files (i.e. directories) are defined as a set size when you create them - actually a base size plus expansion block size, but there is a limit of 15 expansion blocks - none of this can be re-set. Once a library has been allocated, and used, a certain amount of space, then that space is permanently assigned to that library (unless the library is deleted) and not available to any other, even if files in the library are deleted. Libraries require regular cleaning, otherwise they will eventually become full - this is not just a question of deleting unwanted files, to release the space it is necessary to run a compression routine. It is necessary to make sure that a library has a suitable setting for record length and file organization for the type of files it will contain.

There is a limit (~15) on the number of batch jobs any uid can have in the queues - this includes output from jobs that have already run.

Sometimes, when a job/process is to create an output file, it is helpful/necessary to have a file of that name already existing, to define the format of the output file.

Error messages are the usual IBM gobbledygook - there was a (Japanese) manual somewhere in the next room which translates these messages, but I have not been able to find it recently. A Japanese colleague may well be able to recognize an error message from the error number given.

With the limited storage for permanent files, it is often necessary to use the temporary file space that is allocated to the section. This, even more than the permanent space, is subject to competition, with multiple users trying to use the same space concurrently - it can be necessary to co-ordinate your calculations so as not to clash for file space with other section members. The temporary filespace is called 'weekly' storage, but if it is full it may be cleared out more frequently by the operators (the same applies to batch job output - it is kept on-line for a nominal week, but it can sometimes be deleted earlier).

Be aware that you should do your own archiving of files kept on the FACOM. There is a tape cassette reader in the computer building to which you have direct access. For storage of batch job output, I now transfer this (FTP) to the Macintosh on my desk (in 2 steps, via the section's

Unix workstation), and store the files on 230 Mb demountable MO disks. Whilst files can be sent back to the FACOM, I have experienced some problems with this, so would not suggest using this route to archive data/JCL files that might want retrieving to the FACOM.

5 Comments on the Calculations.

There are essentially two separate sets of programs for running the calculations. The hallmark of which system is being used is the number of characters in the names used to identify the different material zones of the reactor model, either 5 or 6 characters.

The older versions of the programs use 6-character names: these programs allowed only a single character to identify different isotopes within cross-section data, as a result a maximum of 34 isotopes were allowed. The later version re-assigns one character, using 5 to identify zone and 2 for the isotope - a maximum of 99 isotopes is now possible. The larger number of isotopes is particularly necessary for calculations dealing with minor actinide burning. Note that if a zone name in an input file is less than the required 5/6 character, the programs fill the blanks with '$' signs; also, excess characters may be truncated; so the number of characters in data in an input file is not an infallible guide to the program version being used. (Note that on some Japanese machines, 'dollar' and 'yen' symbols are interchanged, on others this applies to the 'yen' and 'backslash'.)

Not all programs are available in the updated (5-character) format. Both for the purposes of changing between the 5 and 6-character calculations, and to adopt any updated/ corrected programs that become available, it is generally sufficient to just change the program module names in the JCL files.

The 70-group nuclear data is a single set of data which is used for all material compositions. When condensed (7 or 18 group) datasets are produced, these include separate data entries for a number of different material compositions (i.e. each condensed from 70 groups using a flux from a zone with the appropriate composition). In (some) condensed datasets, the data for each material zone include microscopic cross-section data for all 150 nuclides of the JENDL library; because of the bulky nature of this data, such condensed datasets can only represent a limited number of different material zones. In particular, these datasets only have one entry for each fuel Pu enrichment zone, despite the variation in composition across such a zone (a consequence of the burn-up distribution).

Because of the above nature of the condensed datasets, the 'iterative condensation' S-J-C calculations (used to produce the condensed datasets) used a simple geometric representation, with the number of material zones corresponding to the number of condensed cross-section dataset entries - thus each core enrichment zone has a uniform burn-up. The remainder of the CITATION based calculations use a more detailed material zone representation, with axial and radial burn-up (i.e. number density) variation modelled. I found that a larger level of detail than had previously used in the PNC route was

necessary: this was because of the importance of leakage (especially in Na void) to the breederless cores I was modelling - it was sensitive to the number density variation near the core edge.

In the original PNC calculational route (which used fewer material/number density zones to represent the core), the calculations of data for the PERKY perturbations included the production of condensed cross-section data. With the increased number of zones in my models, this encountered problems over trying to create files large enough to include the full 150 nuclide microscopic data for each material zone. I modified the calculation slightly, so that microscopic cross-section data were only stored for a single material zone (one for each of the normal, Doppler and Na void core states), these values being used for all zones in the PERKY calculations.

In the MOSES burn-up calculations, the radial burn-up/number density mesh is automatically set at 1 mesh per S/A by the program. The axial number density mesh corresponds to the AXIAL input parameter (8 meshes in the example datasets). Thus, the MOSES burn-up calculation has a much more detailed material mesh representation than the PENCIL and S-J-C (RZ) calculations, as well as a more accurate flux/rating representation.

In the rod worth (snapshot) MOSES calculations, I originally used a restricted total of just 15 zones for all materials, averaging data from the more detailed CITATION calculations to provide number density input. This restriction was due to a misunderstanding of how MOSES worked; the program is not in fact limited to 15 zones of number density input. I would recommend as far as possible maintaining the same zones as are used in the CITATION calculations. It is only practical to consider radial n.d. zones in MOSES that consist of S/A rings (or part rings, where caused by material zone boundaries). To transfer number densities from CITATION to MOSES, some of the narrower CITATION radial zones may have to be combined.

The radial (number density) mesh boundaries used in CITATION (RZ geometry) should be carefully chosen to correspond (where possible) to S/A ring boundaries in the hex-Z geometry of MOSES.

The 'perturbation' block of calculations is carried out using the original, 6-character, versions of the programs - a version capable of handling large arrays (i.e. a large model) was needed, and some 5-character program versions could not meet the requirements. These perturbation calculations are also limited to a maximum of 40 material zones in the model (the limit comes from some of the JOINT programs), it was necessary to adopt a simplified version of the zone structure used in the 'basic fuel cycle' and other calculations - it was still significantly more detailed than that used in the 'iterative condensation' calculations. (The PERKY package-based calculations for

the 'shutdown margin' block make use of the newer, 5-character, name versions of the programs; it also uses the fully detailed material zone model.)

The program restriction on numbers of material zones that is most likely to be limiting comes from PENCIL: no more than 24 material zones in either Pu enrichment zone.

The example datasets have both fuel and absorber zones modelled heterogeneously in the SLAROM cell lattice calculations. The fuel heterogeneous model is included so that non-fuel materials can be excluded from the temperature changes of Doppler calculations; the more accurate modelling of fuel self-shielding is an added bonus (the effect is minor). The original PNC calculational route included no method for absorber rod homogenization (not a problem in those calculations, since absorber was only modelled in the 3D MOSES rod worth calculations, and one of the rod worth adjustment factors applied was for rod homogenization). I considered it important to include the absorber in the more detailed model I was using, especially since I was looking at B_4C diluent in the core, and its effectiveness could be affected by the presence of the same material in the rods. The heterogeneous cell model used for absorber was designed for fuel element modelling, however, it appears to give reasonable results, and it is important to have some method of representing absorber heterogeneity effects.

I have continued to use homogeneous absorber in the MOSES rod worth calculations (not the burn-up), rather than alter the rod worth adjustments to remove the compensation for absorber heterogeneity effects. (It might be a good idea to change this, just using heterogeneously modelled rod absorber throughout.) The method I have used requires two sets of absorber nuclear data to be included in each condensed nuclear dataset: the S-J-C calculation of the 'iterative condensation' just models heterogeneous absorber in the CITATION calculation, both heterogeneous and homogeneous absorber models are included in the SLAROM calculation, and both are condensed by JOINT, using the single absorber flux calculated by CITATION.

The MOSES calculations have generally used the option for 1 mesh per S/A, with the ratings interpolated to 6 meshes per S/A (using the Askew method). The more detailed 6 mesh per S/A option works, but the extra computer time used does not much alter the results obtained. In some cases I had to use the more detailed calculation, because the other option would not converge. The MOSES option to include an interpolation of number density as well as flux to 6 meshes per S/A is not yet implemented in the program.

As to the insertion of the control rods into the core, for certain calculations these are fixed. The 3D MOSES 'rod worth' cases have rod positions defined as a key part of the calculations. For the PENCIL calculations, rods must be fully withdrawn, since the reactivity target is defined

for that condition. In the case of the '3D burn-up' MOSES calculations, rod insertions are to be adjusted to give the desired Keff value and radial rating profile. As to the remaining calculations - those involving CITATION - I have adopted the following rod insertions: fully withdrawn for cases used in reactivity difference calculations (this being the most suitable reference state); an average of BOC & EOC insertions (30% in the example files) for cases used in the condensation of nuclear data. [Note that, in the example calculations, the cases producing nuclear data (& fluxes) in the 'perturbation' and 'shutdown margin' blocks all used rods fully withdrawn. This is correct for the 'perturbation' cases, since they are for the EOC state. The 'shutdown margin' cases are for BOC conditions, they should ideally be performed for an appropriate rod insertion - in practise, any difference should be negligible.]

Many (but not all) of the programs still use fixed format input: not only the position of numbers within each card, in some places specific numbers of blank cards are required to be input. (You have been warned!)

The example files of the following Section are all for the same core & fuel cycle calculation (there are exceptions, but they are not significant). Here is a brief description of the relevant details. A breederless reactor, with 2 core zones of different Pu enrichments. The detailed model represents a total of 52 different material zones, in 8 groupings: inner core - 8 axial zones, outer core - 3 radial x 8 axial zones for a total of 24 zones, 4 plenum zones, 4 plugged pin zones, 5 zones of rod follower or wrapper without pins, 2 zones of steel shield, 1 of B_4C shield, and 4 of rod absorber. Within each one of these 8 groupings the zones have the same number density (for a clean core); this provides 8 separate material zones in the 'iterative condensation' calculations, and the condensed nuclear datasets. The rod absorber is included as both heterogeneous and homogeneous cell models, giving a total of 9 entries in the condensed nuclear data. In the MOSES rod worth calculations, the above detailed model is used, but with the number of outer core zones reduced from 24 to 16. The fuel cycle is in 4 batches of 9.75 months.

6 The Calculational Route - a Detailed Description.

For a full description of each input option, refer to the particular program's manual for further details. SLAROM and CITATION have manuals in English[1,2], other programs have manuals only in Japanese (if at all). Appendices I to IV describe the input requirements of PENCIL, CITATION, PERKY and MOSES. The minor programs (e.g. JOINT) have their input described in the main text. Example JCL and data files are listed in Appendix VII.

A number of figures have been included, as an aid to understanding the calculational route. Figure 6.1 shows how the different blocks of the route fit together, and the main parameters calculated in each block. For the 6 blocks, each figure 6.2 to 6.7 shows the flow of data between calculation steps for one block; to aid clarity, some of the less significant datasets have been omitted; figure 6.5 includes the symbol conventions used in all 6 figures.

When using the route, the initial part of JCL and data file names - POC0B17 in the example files - will have to be altered to whatever FACOM uid is given to the user. You are of course free to completely change the filenames, they are only used here to help define where the same (or similar) files are used in different places. Note that other file names - principally program load modules, but also some standard data files (e.g. JENDL-3.2 70-group data) - represent fixed files used by the whole section, and they should not generally be altered.

6.1 Iterative Condensation block

6.1.1 PENCIL Calculation

The PENCIL calculation for the 'basic fuel cycle' is identical to this calculation.

A batch job run using JCL file [1], with Data files [1] & [2] as input (see appendix VII for example file listings).

File .OBHZHBC3.MIC18G3 is an 18-group 'micro' file produced by the S-J-C calculation in an 'iterative condensation'. A pre-existing data file is used to start the first iteration; in later iterations this file is then taken from the S-J-C run of the previous iteration.

Files .PQINT.DATA(APPLE) and .PQINT.DATA(TABLE) are temporary files transferred between the different program blocks. They can be used to provide summary table/graph plotting output.

File .PQINT.DATA(CIT) provides input to the next step, CITDENS. [For the 'basic fuel cycle' block, this file is also used as input to the 'shutdown margin' calculations.]

Data file [1] - .OPDEND.DATA(GDI1P) - is input to PENCIL which allows it to calculate core/breeder number densities from geometric data, and also provides parameters controlling the iterations of PENCIL. Appendix I gives details of the various parameters, various points of note are given here.

I have not run the program with breeder zones, so cannot give guidance on its effects.
For the 'iterative condensation', LAST=1 is necessary to ensure the same case in each iteration. For 'basic fuel cycle', a larger number is used, but not so high that CPU time can expire.
ICZ, OCZ (+ABZ, RBZ, IBZ) are the CITATION material zones for which number densities will be produced (see data file [2]).
PENCIL is set up to recognize 85 specific nuclides, in a particular order; the NUID number must be non-zero for any isotope actually present.
Lines beginning '&' are necessary block control commands; the lines beginning 'inner ..' & 'outer..' are comment lines.
The particular case shown has both ZrH and B_4C diluent replacing some fuel - it uses NZRH, VB4C and associated parameters.
Note that the F parameter should have been increased to values for 18 groups (this is not important, the 8'th to 18'th values should take the default values).

Data file [2] - .OPCITD.DATA(O975M165) - is the data for the CITATION run which is embedded within PENCIL. The data is in a series of blocks, identified by the lines reading '001', '002' etc. This is not quite the standard form of CITATION input: the number density data, block '020', excludes the core (& breeder) materials - zones 1 to 32 in this case - as they are calculated by the PENCIL routines. Whilst there is an English manual[2] for CITATION, I include Appendix II describing some of the important features used.

Burn-up calculations use a detailed geometric model: 52 zones, 32 are core - see block '012'.
In this case, microscopic x-sections and number density data are input. The N.D. data uses nuclide identification numbers in the same format as PENCIL.
Refuelling sequencing is set up for using a fixed feed fuel composition (i.e. no re-cycling). Although each core zone is represented as a smeared number density in flux calculations, within each zone the number densities of each refuelling batch are represented as a sub-zone for the burn-up calculations. 'Feed stream', 'makeup stream' and 'fuel movement' is defined once for each fuel zone; just one 'discharge stream' is defined (since no further use is made. I think it should be possible to use 1 'feed stream' and 1 'makeup stream' per enrichment zone.

[Note, the CITATION input also defines a zone class. I have maintained a simple correspondence of 1 zone to 1 zone class.]

6.1.2 CITDENS Calculation

The CITDENS calculation for the 'basic fuel cycle' is identical to this calculation.

A batch job run using JCL file [2].

The data file .PQINT.DATA(CIT) was created by the preceeding PENCIL calculation.

The cross-section file - .OBHZHBC3.MIC18G3 - must be the same as used in the preceeding PENCIL calculation.

The output file .@GDI1.DENS is the number density data for all timesteps during the burn-up calculation. It is read as input by RZOUT3, and by other programs.

6.1.3 RZOUT3 Calculation

An interactive procedure, run by a Macro.

The program extracts number density data from CITDENS output; it transforms the data to the SLAROM input format; it can combine material zones (calculating average number densities) to give the output for an altered set of zones.

To make the MACRO available within an interactive session, need to run the enablement file, JCL file [3] - .TSS.CLIST - by inputting the following commands at the command prompt:

```
STREAM COMMAND
EX TSS
LOGON
```

This executes the file named 'TSS' (of type 'CLIST') during the re-login which is initiated. You should only need this procedure again if either of JCL files [3] or [4] are changed.

The actual MACRO is run by typing 'RZOUT3' at the command prompt, this initiates the Macro, JCL file [4] - .TSSMAC.CLIST(RZOUT3). You have to follow this with certain typed input that the program requires.

It will be necessary to edit both JCL files [3] and [4] to handle the filenaming convention and uid that you employ.

The 2 typed input parameters that RZOUT3 requires, and prompts for, are:

```
'input'  file identifier
'output' file identifier
```

if a null value is given for 'output', then it takes the same value as 'input'.

There are 3 files associated with running RZOUT3:

```
.@'input'.DENS  the number density file created by CITDENS
.OPEDID.DATA('input'RZ)  control data, data file [3]
.OPFORT.DATA('output'RZ)  output file, data file [4]
```

The example files are for the case
'input' = 'output' = GDI1

The input is shown in data file [3] - .OPEDID.DATA(GDI1RZ). The data shown is actually not for the 'iterative condensation' case, the minor differences are noted in the following explanation of the input.

The program assumes 3 different types of zone: core/breeder, structure, absorber; input is for each type, in order.

NID — no. of nuclides used in each zone type

IDCIT/IDSLA — corresponding identifiers for each nuclide, in CITATION (i.e. PENCIL) and in SLAROM formats

NEWZN — position in the new series of zones (in SLAROM output) that each zone of the input (CITATION) n.d. is mapped to

{The example file shown has no reduction in the number of zones, it is appropriate to the 'basic fuel cycle' case; for the 'iterative condensation' case SLAROM uses a less detailed 8 zone model, with
NEWZN(1)=8*1,24*2,4*3,4*4,5*5,2*6,7,4*8,38*0,}
[n*m is equivalent to: m repeated n times]

ZNGR — value (1,2 or 3) indicating zone type, for each zone in the SLAROM output

{For 'iterative convergence' case, ZNGR(1)=2*1,4*2,2*3,}

ISTEP — step in n.d. input file from which data is taken, calculated as (C-1)*(S+1)+T
C - no. of cycle
S - steps/cycle; 2 (BOC,EOC) if cycle < 1 year
3 (BOC,MOC,EOC) if cycle > 1 year
T - time in cycle; BOC T=1, MOC T=2, EOC T=S

{For 'iterative convergence', step is BOC, ISTEP=16)

NZONE — no. of zones in CITATION and in SLAROM data

{For 'iterative convergence' case, NZONE=52,8,}

Data file [4] - .OPFORT.DATA(GDI1RZ) - shows the output. It is used in the Hand Edit step (next) to create the SLAROM input data file for an S-J-C calculation This example file actually corresponds to the case of the input data in data file [3] - the 'basic fuel cycle' calculation (for EOC).

The output file has number density data, in both the CITATION (PENCIL) and SLAROM input formats. These data include any reduction in the number of material zones carried out by RZOUT3. To save space, several blocks of repetitive data have been deleted from the files as printed for this note.
All the data is in the form of pairs of nuclide ID and number density (atoms/cc x 10^{-24}).

6.1.4 **Hand Edit**

This step takes the SLAROM format number density data output by RZOUT3, data file [4], and produces the SLAROM data used in the S-J-C calculation, data file [5].

The editing procedure used to be carried out by hand but, especially following the introduction of a 2-region/2-temperature model for the fuel, it has become sensible to adopt an automatic editing program. A program (EDSLA) is being written that will be able to produce SLAROM data files (for either 1-region or 2-region fuel cell models), and so will replace this 'Hand Edit' step. A separate user guide and program description for EDSLA will be published[3]. For now I just describe the output file that has to be created.

Data file [4] - .OPFORT.DATA(GDI1RZ) - contains number density data in the format required in a 'SLAROM data' file; it was created by the foregoing RZOUT3 calculation. Each block of nuclide/number density data in SLAROM format is taken from the input file, removing the 'ZONE nn' line, and used as the basis for one material zone in the 'SLAROM data' file that is created. (Note that data file [4] is actually a 52 zone version for the 'basic fuel cycle' block, whilst the output data file [5] is for the 8 zone model of the 'iterative convergence'.)

Data file [5] - OPDEND.DATA(GDG0S) - is the 'SLAROM data' file that is created for use in the following S-J-C calculation. It consists of SLAROM input data for each material zone. Each fuel zone has the n.d. data adjusted to fit the 2-region representation; the rod absorber zone is modelled twice, the second time as a multi-region representation; all remaining zones are modelled as 1 (homogeneous) region, with n.d. data unaltered from the input values. For a full description of SLAROM data see the manual[1], the following gives a brief description of the important items:

PREP - codeword at start of new zone (for homogeneous zones the only codeword)

Title line

Control Data

field 1	no. of regions in cell; 1 if homogeneous, otherwise 2/6 for fuel/absorber
field 4	0/1 for homogeneous/heterogeneous case
field 5	use 0/1 - slab/cylindrical cell for homogeneous/heterogeneous
field 7	value >0 for JENDL-3.2 nuclear data
field 8	-ve value, SLAROM will include all micro. data in nuclear data PDS (0 - no micro. data included)

Control Data

field 1	temperature or temperature of non-fuel isotopes + 10^4 {Manual description is incomplete}

field 2 0 - homogeneous,
1.3 - recommended for heterogeneous cell
Temperatures fuel temperatures, 1 value per region: (for heterogeneous model with non-uniform temperatures, only present if 'Control Data', field 1 > 10^4)
Nuclides no. of isotopes in each region
Width thickness of each region
n.d. ID and number density of each nuclide, data for each region starts on a new card

PATH - codeword, only used for heterogeneous zones

Title line
Control Data
field 2 no. of zones in cell, 2/6 - fuel/absorber
field 5 manual says use same value as in 'PATH' block, (1); example fuel data I was given had value 0
Geometry Data - the SLAROM manual refers to 'region', 'zone' and 'material' model sub-divisions, in my calculations these were identical, all equivalent to the regions of the PREP data.
field 1 3 sets geometry as cylindrical
fields 2,3,5 the no. of regions, 2/6 - fuel/absorber
fields 9,11,12,15 fuel values were taken from an example dataset; absorber calculation was made more detailed (it seemed prudent)
Region Data mapping of 'material' data (input in PREP) to 'SLAROM regions' of the geometry [always 1:1]
Size radius of each cylindrical region of the cell model

PIJF - codeword, only used for heterogeneous zones

Control Data
Convergence Data where input is zero, default value is used
Control Datum 0 value stops activation cross-section input

EDIT - codeword, only used for heterogeneous regions

Control Data
field 4 0/1 - all/sub-set of regions are included in averaging of cross-sections
Sub-set Line only present if above item is '1'. 1'st & last included regions (values repeat). Only used in rod absorber model, to exclude fuel surrounding absorber S/A in supercell.
'NAME' - name given to zone by SLAROM and associated calculations (may be truncated to 5 characters).

The absorber heterogeneous cell model consists of 6 cylindrical regions. The inner 5 regions comprise a single absorber S/A, with the 6'th region consisting of the homogeneous fuel composition, to a size corresponding to the fuel:absorber ratio in the core. (It is possible to run RZOUT3 again for every case, producing a single reactor average fuel composition. Rather than this extra

calculation, I have just taken the inner core n.d. from the equivalent of data file [4].) Region 5 is the S/A wrapper, steel of a volume taken from the rod follower zone. Region 4 is Na coolant, at a volume taken from the absorber S/A data. The remainder of the steel in the absorber S/A forms region 3, the sheath round the absorber. The absorber itself is region 1 - at its actual, not theoretical, density. Region 2 was the small remaining volume fraction - the gap between absorber and sheath: I filled this with Na (at greatly reduced density) to avoid any possible problems with an empty region. For the 5 inner regions, n.d. values were just those of the component material - Na, steel or B_4C, the latter reduced to its fraction of theoretical density.

The fuel heterogeneous cell model consists of 2 cylindrical regions. The inner region is just fuel material, with the radius of a fuel pellet. The outer region consists of all other materials in the fuel zone - steel wrapper and clad, Na coolant, diluent - of a radius such that the fuel pellet region has the same fractional volume as does the fuel in the S/A. The fuel pellet region has the same fraction of theoretical density as the actual fuel pellet, except that any central hole in the pellet is smeared into the fuel pellet region, reducing the density. The number density data from the RZOUT3 calculation has to be increased; for each cylindrical region a multiplier of the inverse of the zone volume fraction is used - thus maintaining the average density over the whole cell model.

The non-uniform temperature representation is used for the 2-region fuel cell model. I do not know exactly which are the fuel isotopes that the region dependant temperatures are applied to. There appear to be further difficulties with the non-uniform temperature model, I had problems trying to implement a 3-region - bore:fuel:other material - hollow pellet model.

To provide SLAROM data for an S-J-C calculation that produces 18-group nuclear data for shutdown temperatures, an extra Hand Edit is done, producing output that only differs from data file [5] in having a uniform 473 K temperature.

6.1.5 **S-J-C Calculation**

A batch job using JCL file [5], it is actually a series of linked calculations. A SLAROM cell calculation of macroscopic nuclear data; a CITATION flux snapshot calculation; JOINT condensations of nuclear data, and various interface routines (also part of JOINT).

The SLAROM step uses as input the data file [5] - .OPDEND.DATA(GDG0S) - created by and described under the foregoing Hand Edit.

File POC0H##.JFS3J3.Y9406 is the 70-group JENDL-3.2 data, input in a section standard data file (a fixed data file).

Macroscopic nuclear data, to be used by CITATION, are stored in the internal file designated &&XSG70 - this also includes the microscopic nuclear data which is to be condensed by JOINT; it is the size of this file that limits the number of material zones modelled in this calculation.

The CITATION step uses as input data file [6]. It also uses the macroscopic nuclear data of file &&XSG70 - this is in place of the microscopic nuclear data and number densities as used in the CITATION calculation within PENCIL.

Data file [6] - .OPCITD.DATA(PHA1N70) - is the geometric and other standard CITATION data. This is essentially the same as data file [2], but with certain differences.

As just a snapshot (i.e. no burn-up) calculation, data blocks '002', '018', '034', '036', '091' and '093' are not required (they are only for burn-up calculations).
Blocks '004' and '005' represent a much reduced number of material zones.
Blocks '012' and '020' are not used since macroscopic nuclear data replaces the microscopic nuclear data and number densities of the PENCIL dataset.
A modified version of the CITATION input is used, allowing an easy interface with the JOINT routines and nuclear data from SLAROM. Data blocks '008' and'023' are non-standard input, as are the 2 lines before the title.

Initial Lines

Program name
A material name (from 'SLAROM data') - use 1'st (core) zone, it has all 85 (PENCIL) nuclides present.

Block '008'

line 2
- field 1 no. of energy groups (minus sign indicates input from PDS file)
- field 2 no. of energy groups for downscatter
- field 3 no. of energy groups for upscatter
- field 4 number of material zones

line 3+ ID of material used in block '005'

line 4+
- field 1 name of material zone in SLAROM calculation (note, 5 characters)

line 5 (space)

line 6 material zone supplying fission spectrum data

Output from the CITATION step, to be used by JOINT, are placed in the internal file designated &&CIT.

There are 3 condensation and associated JOINT calculation steps. The extraction of fluxes from the CITATION output; the condensation of microscopic nuclear data (using the

extracted fluxes); the transformation of condensed nuclear data to a format used by PENCIL/CITATION. Data files [7], [8] and [9] provide control data used in the 3 steps.

The internal files &&XSG70 and &&CIT transfer output data from the SLAROM and CITATION steps of the calculation. A temporary file - .@GDG170.FLUX - holds the fluxes extracted from the bulk of CITATION output.

Condensed microscopic nuclear data are produced in 2 files: temporary file .@GDG118.PDSMIC , a 'partitioned dataset' (a library of various files), the format used by SLAROM; a single binary file .OBHZHBC7.MIC7GJ3 , the format used by PENCIL and CITATION. The 2 datasets also adopt the 2 different nuclide numbering schemes.

Data file [7] - .OPEDID.DATA(PFC1F) - lists those material zones for which fluxes are to be extracted

line 4
- field 1 number of energy groups
- field 2 number of zones/fluxes to extract

line 5+ names of material zones (note 5 characters)

Data file [8] - .OPEDID.DATA(PFC1C) - controls the actual condensation

line 4 number of groups after condensation {Note this particular file is for 7-group, not 18-group, condensation.}

line 5 lower energy group of each condensation band. {For 18 groups, standard data is - 2, 4, 6, 8, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, 70.}

4 lines for each condensed nuclear data set
- PDSIN zone name of data to be condensed
- PDSOUT zone name of condensed data
- USERPDS zone name of flux used in condensation
- Title line.

Note that the 2 absorber datasets (homogeneous and heterogeneous) from SLAROM are both condensed using flux from the same zone in CITATION.

Data file [9] - .OPEDID.DATA(PFC1M) - controls the transformation of condensed nuclear data between SLAROM (PDS) and CITATION (binary file) formats

The 1'st block inputs some data on all nuclides used in the PENCIL/CITATION data format:

line 2 name of 1'st fuel zone (1'st zone with all 85 nuclides)

line 3 total number of nuclides

line 4+
- field 1 nuclide PENCIL ID number (in order)
- field 2 nuclide SLAROM ID number
- field 3 atomic weight
- field 4 energy per fission

Subsequent blocks - 1 for each material zone in condensed nuclear data:

line 1
- field 1 material zone name (note 5 characters)

field 2 no. of nuclides for which data is stored (all nuclides used for fuel zones)
field 3 descriptive title
line 2 PENCIL ID numbers of nuclides stored

To produce nuclear data condensed to both 7 and 18 groups, the whole S-J-C calculation can be repeated, with the condensation data of data file [8] differing as described above. Alternatively, the 3 final job steps - JOINT2, JOINT3 and MICRO - can be repeated at the end of the job: the step names will have to be changed, as will the names of temporary files created (to prevent duplication); also, in the first JOINT2 step, for file &&CIT alter '(OLD,DELETE)' to '(OLD,PASS)'. [Note, I have not actually used this second method, preferring to repeat the whole S-J-C calculation after I am satisfied Keff has converged.]

For the condensation of nuclear data in 7 groups at shutdown temperatures, the S-J-C calculation is repeated, but with the appropriately modified data replacing the SLAROM input of data file [5].

The CITATION format microscopic data file - .OBHZHBC7.MIC7GJ3 or its re-named equivalent - from the final iteration is used in various of the subsequent calculation blocks (e.g. 'basic fuel cycle').

6.2 Basic Fuel Cycle block

6.2.1 PENCIL Calculation

This is identical to the PENCIL calculation in the 'iterative condensation'.

A batch job run using JCL file [1], with the 18-group 'micro' file .OBHZHBC3.MIC18G3 being the condensed data produced by the final iteration of the 'iterative condensation'.

6.2.2 CITDENS Calculation

This is identical to the CITDENS calculation in the 'iterative condensation'.

A batch job runs using JCL file [2], with the 18-group 'micro' file .OBHZHBC3.MIC18G3 being the condensed data produced by the final iteration of the 'iterative condensation'.

The temporary data file used to control the calculation - .PQINT.DATA(CIT) - and the number density output file - .@GDI1.DENS - are used in some of the later calculation

blocks (e.g. shutdown margin).

6.2.3 **MASSN Calculation**

A batch job run using JCL file [6], this JCL file includes data.

File .GDI1.DENS is the number density multiple-entry dataset created by the above CITDENS calculation. (The change of name, removing '@', corresponded to copying the temporary file to permanent filespace.)

JCL file [6] - .OPJCL.CNTL(GDI1MASS) - contains the following data:

- line 1 — cycle length (days, integer); no. of cycles fuel is irradiated; pin clad outer diameter (mm); wire diameter (mm)
- line 2+ — total no. of zones in CITATION calculation; no. of nuclides modelled in each zone
- line 3 — no. of zones in inner core; zone ID no.'s
- line 4+ — no. of zones in outer core; zone ID no.'s
- line 5 — no. of zones in axial blanket ; zone ID no.'s [0 0 if no zones]
- card 6 — no. of zones in radial blanket; zone ID no.'s [0 0 if no zones]
- line 7
  - field 1-3 — No. of S/As in inner core/outer core/ radial blanket
  - field 4 — No. of cycles stored on multiple n.d. file [-ve if MOC included (i.e. cycle length > 356 days)]
  - field 5 — Radial blanket irradiation (cycles)
  - field 6 — PENCIL ID of ^{238}Pu isotope
  - field 7 — 0/1 for half/full core height modelled [note - example dataset has wrong value, causes factor 2 error in all masses.]
- line 8, — title

The only output is the results (i.e. no file of data for use in further calculations).

(A modifired version of the MASSN program, a more flexible and general version, is being produced; a separate user guide and program description[4] are being produced.)

6.2.4 **RZOUT3 Calculation**

This is virtually identical to the RZOUT3 calculation of the 'iterative condensation' block, an interactive procedure run by the Macro RZOUT3.

The subsequent S-J-C calculation is to use the full detail (52 material zones) of the PENCIL calculation, so the input and output files will actually be of the forms shown in

data file [3] and data file [4], rather than with the slightly different data of the 'iterative condensation' calculations.

It is carried out twice, for both BOC and EOC steps of the final (6'th) iteration of the CITDENS burn-up calculation (ISTEP values of 16 and 17).

6.2.5 **Hand Edit**

This procedure is virtually the same as that carried out under the Hand Edit step of the 'iterative condensation' block. The input, from the above RZOUT3 calculation, has a larger number of material zones, hence the larger number of zones in the output, which is shown as data file [10] (with repetitive data deleted, to reduce the length of the printed file).

One change to the output file is that on the Control Data line of the PREP block, the 8'th field is altered to zero. (Since no condensation is to be done using this data, no microscopic data need be included in the output produced by SLAROM in the S-J-C calculation.)

A total of 5 different output data files are produced. The BOC and EOC versions of the input data from RZOUT3 give 2 standard cases. The EOC case also has 2 modified versions: with all Na (nuclide 11) n.d. set to 0.0 in fuel zones (Na void state); with fuel pellet regions in fuel zones having temperatures increased 500 degrees (for Doppler calculation). the BOC case has the modified version of a uniform 473 K temperature (shutdown temperatures).

(When it is available, the EDSLA program[3] can replace this 'Hand Edit' step.)

6.2.6 **S-J-C Calculations**

This is similar to the S-J-C calculation of the 'iterative condensation' block, but the JOINT steps of the calculation related to the nuclear data condensation are excluded.

A batch job run using JCL file [7], with Data files [10] & [11] as input.

File POC0H##.JFS3J3.Y9406 is the standard 70-group JENDL-3.2 nuclear data file (a fixed data file).

Macroscopic nuclear data, to be used by CITATION, are stored on the internal file designated &&XSG70. This does not include the microscopic nuclear data since no JOINT condensation is carried out, hence the much increased number of material zones is possible.

Data file [10] - .OPDEND.DATA(GDI1S) - was created by the above Hand Edit.

Data file [11] - .OPCITD.DATA(PEE1D70O) - has no significant difference from data file [6], the equivalent data file in the 'iterative condensation' S-J-C calculation. The more detailed model alters the geometry data of blocks '004' and '005', and the material names of block '008' (and the pre-title data); some output options of block '001' line 3 are changed; a reactor power value is input, rather than taking the 1 MW default value.

Note that the JOINT program has to be re-compiled in program step DATAP2, to increase the array size so that it can handle the large model used in this calculation.

The calculations produce no further data files.

The S-J-C program is run once for each of the 4 or 5 datasets created by the previous Hand Edit.

6.3 Perturbation block

Unlike in the 2 previous blocks, a single SLAROM calculation is used to provide data used in a series of CITATION calculations, so they are submitted as individual jobs, rather than the combined S-J-C calculation.

The PERKY program version used differs from that of the (Japanese) manual[5], in that it is modified to take data from the JOINT interface routines. Appendix III describes the data input required by PERKY, to the extent that I am familiar with.

6.3.1 RZOUT3 Calculation

This is virtually identical to the RZOUT3 calculation of the 'iterative condensation' block, an interactive procedure run by the Macro RZOUT3.

The subsequent SLAROM calculation uses a reduced number of material regions - 8 in each fuel enrichment zone and 6 for all other materials. To achieve this, the control input data differs from data file [3] in the following way:

```
NEWZN(1)=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,9,10,
         11,12,13,14,15,16,9,10,11,12,13,14,15,16,
         4*17,4*18,5*19,2*20,21,4*22,38*0,
ZNGR(1)=16*1,4*2,2*3,
ISTEP=17
NZONE=52,22,
```

(The shield region immediately before the rod absorber includes B4C, so it is classed as an absorber region in RZOUT3. The ISTEP value is for EOC.)

The output differs in form from that of data file [4] only in the reduction of the number of blocks of data, from 52

to 22.

6.3.2 Hand Edit

This procedure is very similar to that carried out under the Hand Edit step of the 'iterative condensation' block (it will, similarly, be possible to replace this 'Hand Edit' step with the program EDSLA, when it becomes available). The input, from the above RZOUT3 calculation, has a larger number of material zones than the equivalent 'iterative condensation' case of data file [4]. The 'SLAROM data' file that is created is shown in data file [12] (with repetitive data removed).

Data file [12] - .OPDEND.DATA(GDI3PRT) - is of the same basic form as its 'iterative condensation' equivalent, data file [5], but there are a number of significant differences:

The data is for use with the earlier versions of SLAROM and other programs, those in which 6-character region names are used. This required the number of nuclides per region to be limited to 34: this was achieved by removing those with a zero number density.

The data from RZOUT3, above, is for a different number of material regions than either previous equivalent calculation, so there are a different number of data blocks to the output. There is just one, heterogeneous, version of the rod absorber material region modelled.

After the 22 blocks of data corresponding to the data blocks of the input file, all 16 of the data blocks for the fuel regions are repeated, twice. These repeated blocks are modified: the first set, corresponding to the void state, has Na number densities set to zero; the second set, corresponding to the Doppler perturbation, has fuel pellet temperatures increased 500 degrees. In each case, the material region name is modified to be unique - these modified names are used in the later calculations of the perturbation block.

In the Control Data line of each PREP block, the 8'th field is altered to zero; except that in the first fuel region - including its 'void' and 'Doppler' versions - the -20 value is retained. Microscopic data, used in PERKY, are to be taken from this single region.

6.3.3 SLAROM Calculation

This is similar to the first part of the S-J-C calculation of the 'iterative condensation' block. However, different (6-character) program versions are used.

A batch job run using JCL file [8], with Data file [12] as input.
Data file [12] - .OPDEND.DATA(GDI3PRT) - was created by the above Hand Edit.

File POC0H##.JFS3J3.Y9406 is the standard 70-group JENDL-3.2 nuclear data file (a fixed data file).

Macroscopic nuclear data, to be used in following CITATION and PERKY calculations, are stored in a temporary file - .@GDI3P.PDS70G (replacing file &&XSG70). This only includes microscopic nuclear data for a single fuel region (including 'void' and 'Doppler' variants).

6.3.4 CITATION, 70 groups, 'normal'

This is similar to the 2'nd & 3'rd parts of the S-J-C calculation of the 'iterative condensation' block (the CITATION snapshot and JOINT condensation calculations), however, the final 'MICRO' step is omitted. Also, different (6-character) program versions are used, and the JOINT program had to be re-compiled to handle the large model of this calculation.

A batch job run using JCL file [9].

The CITATION step is basically the same as in the 'iterative condensation' block. It uses as input the 70-group macroscopic nuclear data file .@GDI3P.PDS70G created by the foregoing SLAROM calculation. Geometric type data is input in data file [13].

Data file [13] - .OPCITD.DATA(PIJ3P70N) - differs from the equivalent 'iterative convergence' block input file in the following ways:

Block '001' Line 2
- Field 7 To output fluxes on FT34 (not as Manual)
- Field 12 To calculate both direct & adjoint flux

Blocks '004' & '005' represent the more detailed model.
Block '008' has the increased number of material regions, with the change to 6-character region names (also in pre-title line).
Block '040' is data for the adjoint flux calculation.

Output from the CITATION step, to be used by JOINT, are placed in the internal file designated &&CIT.

The temporary flux file - .@GDI3P.FT34G70N - contains flux data used in later calculations in the 'perturbation' block, both direct and adjoint fluxes, in 70 groups, for the 'normal' core state.

The JOINT steps comprise just the extraction of fluxes from the CITATION output and the condensation of nuclear data to

18 groups. (Only PDS format data is required, so the 'MICRO' step is omitted.) They use as input the same effective cross-section data file - .@GDI3P.PDS70G - as the CITATION step, as well as the internal file &&CIT created by that step. The data files [14] & [15] are also used as input.

Data file [14] - .OPEDID.DATA(PIJ3PF) - is of the same form as data file [7] of the 'iterative convergence' block, defining those regions for which fluxes are extracted. The numbers and names of material regions are different, corresponding to those in the CITATION step. Note the 6-character region names.

Data file [15] - .OPEDID.DATA(PIJ3PC) - is of the same form as data file [8] of the 'iterative convergence', defining the condensation. The condensation is to 18 groups, the material regions are as in the CITATION step (the rod absorber material is only included the once). Note the 6-character region names.

A temporary file - .@GDI3P70.FLUXN - holds the fluxes extracted from the bulk of CITATION output, used for the condensation.

The temporary PDS file - .@GDI3P18.PDSMICN - contains condensed nuclear data used in later calculations in the 'perturbation' block, in 18 groups, for the 'normal' core state.

6.3.5 **CITATION, 70 groups, 'void'**

This is basically the same as the previous calculation, except that there is no condensation, and so no JOINT steps.

A batch job run using JCL file [10]. Geometric type data is input in data file [16], as is the 70-group macroscopic nuclear data file .@GDI3P.PDS70G created by the JOINT condensation of the foregoing CITATION calculation.

Data file [16] - .OPCITD.DATA(PIJ3PV70) - differs from the input of data file [13] in the following ways:

Block '001' Line 2 Field 12 No adjoint calculation
Block '008' has the fuel material region names altered to the 'void' variants (also in pre-title line).
Blocks '023' & '040' are omitted.

The temporary flux file - .@GDI3P.FT34G70V - contains flux data used in later calculations in the 'perturbation' block, direct flux only, in 70 groups, for the 'void' core state.
(No &&CIT file is created.)

6.3.6 CITATION, 18 groups, 'normal'

This is basically the same as the previous 70-group, 'normal' CITATION calculation, except that there is no condensation, and so no JOINT steps.

A batch job run using JCL file [11]. Geometric type data is input in data file [17], as is the 18-group macroscopic nuclear data file .@GDI3P18.PDSMICN created by the JOINT condensation of the 70-group, 'normal', CITATION calculation.

Data file [17] - .OPCITD.DATA(PIJ3PADJ) - differs from the input of data file [13] of the first CITATION calculation of this block in the following ways:

Block '008' Line 2 No. of groups altered to 18
Block '023' - omitted.

The temporary flux file - .@GDI3P.FT34G18N - contains flux data used in later calculations in the 'perturbation' block, direct & adjoint fluxes, in 18 groups, for the 'normal' core state.
(No &&CIT file is created.)

6.3.7 CITATION, 70 groups, 'Doppler'

This is basically the same as the previous 70-group, 'normal' CITATION calculation.

A batch job run using JCL file [12].

The CITATION step is basically the same as in the previous 70-group 'normal' calculation. It uses as input the 70-group macroscopic nuclear data file .@GDI3P.PDS70G created by the foregoing SLAROM calculation. Geometric type data is input in data file [18].

Data file [18] - .OPCITD.DATA(PIJ3P70D) - differs from the input of data file [13] in the following ways:

Block '001' Line 2
Field 7 No FT34 flux output.
Field 12 No adjoint flux calculation.
Block '008' has the fuel material region names altered to the 'Doppler' variants (but not in pre-title line).
Block '040' - is omitted (no adjoint flux).

Output from the CITATION step, to be used by JOINT, are placed in the internal file designated &&CIT. No 'FT34' format flux file is created.

The JOINT steps are the same as in the previous 70-group, 'normal', calculation. They use as input the same effective cross-section data file - .@GDI3P.PDS70G - as the CITATION step, as well as the internal file &&CIT created by that step.

Two data files are input - .OPEDID.DATA(PIJ3PFD) and

.OPEDID.DATA(PIJ3PCD) - which differ from the equivalent files used in the 70-group 'normal' calculation, data files [14] & [15], only in replacing the fuel material region names by those for the 'Doppler' variant.

A temporary file - .@GDI3P70.FLUXD - holds the fluxes extracted from the bulk of CITATION output and used for the condensation.

The temporary PDS file - .@GDI3P18.PDSMICD - contains condensed nuclear data used in later calculations in the 'perturbation' block, in 18 groups, for the 'Doppler' core state.

6.3.8 **PERKY, neutron lifetime**

A perturbation-type calculation of prompt neutron lifetime, in 70 energy groups, using the PERKY program variant ABLE.

A batch job, run using JCL file [13]. Control data is input from data file [19], together with nuclear data and flux files created by the foregoing SLAROM and CITATION calculations.

Data file [19] - .OPEDID.DATA(PIJ3PNL) - provides the data for the PERKY neutron lifetime calculation. Nuclear data are input in just the macroscopic format, for each of the 22 material regions in the 'normal' CITATION calculations.

Other files used:
70-group 'normal' nuclear data: .@GDI3P.PDS70G
70-group 'normal' direct + adjoint fluxes:.@GDI3P.FT34G70N

6.3.9 **PERKY, delayed neutron fraction**

A perturbation-type calculation of delayed neutron fraction, in 18 energy groups, using the PERKY program.

A batch job, run using JCL file [14]. The PERKY load module is re-compiled, to allow a large model to be used. Control data is input from data file [20], together with nuclear data and flux files created by the foregoing SLAROM and CITATION calculations.

Data file [20] - .OPEDID.DATA(PIJ3PDNX) - provides the data for the PERKY neutron lifetime calculation.

Block '003' macroscopic nuclear data are input for each of the 22 material regions in the 'normal' CITATION calculations.
Block '002' microscopic nuclear data, all provided by the same material region, input for each of the 16 fuel regions, for the 8 nuclides producing delayed neutrons. Mapping of microscopic data to material regions has no data (i.e. blank) for non-fuel regions.
Block '005' delayed neutron fraction is taken as independent of energy of neutron causing fission.

These data are standard PNC values (Ref. 6)

Other files used:
18-group 'normal' nuclear data: .@GDI3P18.PDSMICN
18-group 'normal' direct + adjoint fluxes: .@GDI3P.FT34G18N

6.3.10 PERKY, Na void

An exact perturbation calculation of Na void, in 70 energy groups, using the PERKY program.

A batch job, run using JCL file [15]. Control data is input from data file [21], together with nuclear data and flux files created by the foregoing SLAROM and CITATION calculations.

Data file [21] - .OPEDID.DATA(PIJ3PEV) - provides the data for the PERKY Na void calculation.
Block '003' macroscopic nuclear data are input for 38 material regions: each of the 22 material regions in the 'normal' CITATION flux calculations, plus 16 fuel regions from the perturbed 'void' case.
Block '008' the mapping defines each 'normal' fuel region to be replaced by its 'void' equivalent.

Other files used:
70-group 'normal' nuclear data: .@GDI3P.PDS70G
70-group 'normal' direct + adjoint fluxes: .@GDI3P.FT34G70N
70-group 'Na void' direct flux: .@GDI3P.FT34G70V

Note that the PERKY load module used (Y9308) does not allow as large a calculation size as does that (Y9607) used in the following calculation.

6.3.11 PERKY, Doppler (by zone)

A 1'st order perturbation calculation of Doppler, in 18 energy groups, using the PERKY program.

A batch job, run using JCL file [16]. Control data is input from data file [22], together with nuclear data and flux files created by the foregoing SLAROM and CITATION calculations.

Data file [22] - .OPEDID.DATA(PIJ3PFD0) - provides the data for the PERKY Doppler (by zone) calculation.
As in the preceeding calculation, except that the perturbed material region names are the 'Doppler' variants (rather than 'void'). (Minor data changes for no. of groups and 1'st order rather than exact perturbation.)

Other files used:
18-group 'normal' nuclear data: .@GDI3P18.PDSMICN
18-group 'Doppler' nuclear data: .@GDI3P18.PDSMICD
18-group 'normal' direct + adjoint fluxes: .@GDI3P.FT34G18N

6.3.12 PERKY, Doppler (by nuclide)

A 1'st order perturbation calculation of Doppler, in 18 energy groups, with the contributions calculated for individual nuclides, using the PERKY program.

A batch job, run using JCL file [17]. Control data is input from data file [23], together with nuclear data and flux files created by the foregoing SLAROM and CITATION calculations.

Data file [23] - .OPEDID.DATA(GDI3PFD1) - provides the data for the PERKY Doppler (by nuclide) calculation.

Block '003' macroscopic nuclear data are input for 38 material regions: each of the 22 material regions in the CITATION flux calculations for the 'normal' state, plus 16 fuel regions from the perturbed 'Doppler' state.

Block '002' microscopic nuclear data, all provided by the same material region, input for each of the same 38 regions as the macroscopic data. Only 20 nuclides can have data input [presumably must include all perturbed nuclides and burnable nuclides, see block '008']. Map of microscopic data onto material regions includes all 38 regions.

Block '008' only 10 nuclides can be perturbed in any 1 run, need multiple runs to cover all nuclides [but several nuclides have no temperature dependence in JENDL-3.2, so can be excluded: ID's 946, 948, 950, 962, 963, 966, 967, 817, 857, 887, 897]. Unsure of 'burnable nuclide' category (guess it is those nuclides with changing number density), but limited to 10 nuclides. {Consider varying the nuclides chosen, as a sensitivity study.}

Other files used:
18-group 'normal' nuclear data: .@GDI3P18.PDSMICN
18-group 'Doppler' nuclear data: .@GDI3P18.PDSMICD
18-group 'normal' direct + adjoint fluxes: .@GDI3P.FT34G18N

6.4 Rod Worth block

6.4.1 PDSDUMP calculation

A short program that extracts data from PDS format nuclear data files, in this case fission spectrum data.

A batch job using JCL file [18].

The JCL file includes a source listing of the program,

which is compiled at run time; it also includes the control data. The calculation uses as input a PDS nuclear data file, the 18-group file created in the final cycle of the 'iterative convergence' block - .@GDG118.PDSMIC . JCL file [18] is shown using a different PDS data file, taken from a calculation for the 'shutdown margin' block.

In practise it is only necessary to do one of the PDSDUMP calculations, from this and the 'shutdown margin' blocks, since there will be very little or no difference in fission spectra.

[To condense an 18-group fission spectrum to 7 groups, simply add values where groups are combined.]

6.4.2 **RZOUT3 calculation**

This is virtually identical to the RZOUT3 calculation of the 'iterative condensation' block, an interactive procedure run by the Macro RZOUT3.

The subsequent MOSES calculation uses a reduced number of material regions - 16 rather than 24 in the outer fuel enrichment zone and 6 for all non-fuel materials. To achieve this, the control input data differs from data file [3] in the following way:

```
NEWZN(1)=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,
19,20,21,22,23,24,17,18,19,20,21,22,23,24,4*25,4*26,
5*27,2*28,29,4*30,38*0,
ZNGR(1)=24*1,4*2,2*3,
ISTEP=16
NZONE=52,30,
```

The output differs in form from that of data file [4] only in the reduction of the number of blocks of data, from 52 to 30.

The calculation is carried out for just the BOC step (ISTEP=16).

6.4.3 **Hand Edit**

This step takes the SLAROM format number density data output by the above RZOUT3, data file [4], and produces the data used in the following MOSES calculations, as shown in data file [24] (with repetitive data removed).

The editing procedure has been carried out by hand, but it would be advantageous to have a program to automatically alter the number density data to the format used by MOSES. (Such a program, EDMOS, is being written, a separate user manual and program description[7] will be published.) For now I just describe the output file that has to been created by hand. Appendix IV describes the format of MOSES input.

Data file [24] - OPMOSD.DATA(GDI1DY) - is the 'MOSES data' file used in the following calculation.

There are actually 4 different datasets created, with small differences: AXIAL & ASYGROUP data include absorber rod S/A types for 0%, 50% and 100% rod insertions; the cases differ in the S/A types assigned to rod positions in the REFMAP data.
LOADING 1 invokes the 1'st set of S/A loadings in REFMAP (the whole core) - in these steady state calculations, this is the only LOADING used.
360° symmetry is necessary for (some) cases with 1 rod stuck, it is easiest to retain this geometry in all cases.
I inadvertently used NAZN>14 when setting up the model - no problems were encountered.
Uses hex-Z geometry with interpolation of pseudo-tri-Z ratings.
DELDAY value input even for steady state calculation.
In REGION, rod absorber material is given homogeneous version of nuclear data.
The fission spectrum data in MICROXS come from the previous PDSDUMP calculation.
XSNUC lists only those PENCIL nuclides actually present in the model.
Minor Actinides 21 to 28 are set to nuclide class 6, not 3 (following an example dataset I was given).
REACT1 & YIELD are supposedly necessary for steady state calculations (I would have thought that the presence of capture and/or fission cross-section values in the nuclear data file would be sufficient to ensure that these reactions are included in the Keff calculation).
The ATDENS number density data contains, for each material region, a value for each nuclide included in the MOSES calculation (0 if not present) - this is obtained by editing the RZOUT3 output file.
Even though this is a steady state calculation, a refuelling period must be given with the REFUEL data.
REFMAP need not assign a S/A type to each S/A in all the NLAY rings, the radial boundary conditions will be applied at the edge of those S/As assigned by REFMAP.
For the 4 different cases, just the assignments to S/A types 5, 6 and 7 require re-arranging.

6.4.4 **MOSES calculation**

Steady state calculations for different rod insertions; Keff differences are used to calculate nominal values of rod group worths.

A batch job using JCL file [19].

Input is the 'MOSES data' file [24] created in the above Hand Edit.

File .OBHZHBC7.MIC7GJ3 is the 7-group microscopic nuclear data file created in the 'iterative convergence' block.

If the effect of shutdown temperatures on nuclear data is being calculated using MOSES (rather than S-J-C), then one of the above MOSES calculations is repeated, but with the nuclear data file replaced with that created for cold shutdown conditions (from the 'iterative convergence' block).

6.5 Shutdown Margin block

There are 2 separate groups of calculations, calculating the reactivity effects of increasing the core size, and of increasing material densities.

Appendix V shows how the results of the calculations are combined to produce the core expansion reactivity change; this result combines with the reactivity effect of temperature on nuclear data (from previous MOSES or S-J-C calculations). Appendix VI describes the combination of this and other factors to produce values of shutdown margin.

The following is the route for calculating the reactivity effect of increasing core size.

6.5.1 Hand Edit

This procedure takes a 'CITATION data' file, data file [11], and edits it to create the 'CITATION data' file used in the following S-J-C calculation.

Data file [11] - .OPCITD.DATA(PEE1D700) - is the 'CITATION data' file that was used in the 'basic fuel cycle' block.

The output file differs only slightly from the input file - Within data block '004', either the axial or the radial mesh intervals are all increased in size by a set small fraction (I used a factor 1.01). Two datasets are created, one each for axial and radial mesh adjustments.

6.5.2 S-J-C calculation

A batch job virtually identical to the S-J-C calculation of the 'basic fuel cycle' step. The JCL differs from that of JCL file [7] only in having the 'CITATION data' file .OPCITD.DATA(PEE1D700) replaced by the data file created in the above Hand Edit.

The calculation is performed for both of the data files created by the above Hand Edit.

The material density reactivity coefficient calculations

start here. The calculations are rather similar to the 'perturbation' block, except that the model is simplified to a single material region for each Pu enrichment zone, and the '5-character' versions of the programs are used.

6.5.3 **RZOUT3 calculation**

This is completely identical to the RZOUT3 calculation in the 'iterative condensation' block: if a copy of the output file from that calculation is available, then the step does not need repeating here.

If the calculation has to be repeated, it uses the same input files as previously: the number density file - .@GDI1.DENS - created by the 'iterative condensation' CITDENS calculation, and 'RZOUT3 data' file that produces the least detailed model (NZONE=52,8,). The output that is produced will, again, be of the same format as data file [4], but for a lesser number of material regions.

6.5.4 **Hand Edit**

This step takes the SLAROM format number density data output by RZOUT3, similar to data file [4], and produces the SLAROM data used in the S-J-C calculation, data file [25].

The editing procedure is simple enough to make any automated process superfluous.

Data file [4] - .OPFORT.DATA(GDI1RZ) - contains number density data in the format required in a 'SLAROM data' file; it was created by the foregoing RZOUT3 calculation. (Note that data file [4] is a 52 zone version for the 'basic fuel cycle' block; the 'shutdown margin' block actually uses a version with an 8 zone model.)

Data file [25] - OPDEND.DATA(GDI1RZEC) - is the 'SLAROM data' file that is created for use in the following calculation. It consists of SLAROM input data for each material zone.

Each zone is modelled as a 1-region homogeneous model (the rod absorber is only represented the once).
Microscopic data is included for all isotopes of all material regions.
All 8 material regions are repeated, as Doppler versions - the material region names are altered, only fuel region temperatures are changed.

(When it is available, the EDSLA program[3] can replace this 'Hand Edit' step.)

6.5.5 **SLAROM calculation**

This is similar to the first part of the S-J-C calculation of the 'iterative condensation' block.

A batch job run using JCL file [20], with Data file [25] as input. (The JCL differs from that for the 'perturbation' block in using a 5-character program version.)

Data file [25] - .OPDEND.DATA(GDI1RZEC) - was created by the above Hand Edit.

File POC0H##.JFS3J3.Y9406 is the standard 70-group JENDL-3.2 nuclear data file (a fixed data file).

Macroscopic nuclear data, to be used in following CITATION and PERKY calculations, are stored in a temporary file - .@GDI1P.PDS70G (replacing file &&XSG70). This includes both 'normal' and 'Doppler' state variants; microscopic nuclear data are included for all material regions.

6.5.6 **CITATION, 'normal'**

This is similar to the 2'nd & 3'rd parts of the S-J-C calculation of the 'iterative condensation' block, the CITATION snapshot and JOINT condensation calculations. (The JCL differs from that for the 'perturbation' block in using 5-character program versions.)

A batch job run using JCL file [21].

The CITATION step is basically the same as in the 'iterative condensation' block. It uses as input the 70-group macroscopic nuclear data file .@GDI1P.PDS70G created by the foregoing SLAROM calculation. Geometric type data is input in data file [26].

Data file [26] - .OPCITD.DATA(PFC3N70X) - differs from the equivalent 'iterative convergence' input data file in only one particular: the main rod absorbers are modelled fully withdrawn (rather than at the average insertion used in the 'iterative convergence' calculation), thus one less axial material zone is modelled in data blocks '004' & '005'.

Output from the CITATION step, to be used by JOINT, are placed in the internal file designated &&CIT.

There are 3 condensation and associated JOINT calculation steps. The extraction of fluxes from the CITATION output; the condensation of microscopic nuclear data (using the extracted fluxes); the transformation of condensed nuclear data to the CITATION format. Data files [27], [28] and [29] provide control data used in the 3 steps.

The same effective cross-section data file as in the CITATION step - .@GDI1P.PDS70G - is used as input, as well as the internal file &&CIT created by that step. A

temporary file - .@GDI1P70.FLUXN - holds the fluxes extracted from the bulk of CITATION output.

Condensed microscopic nuclear data are produced in 2 temporary files: file .@GDI1P18.PDSMICN , in the PDS format used by SLAROM; file .@GDI1P18.MICRON in the binary format used by CITATION. The 2 datasets use the 2 different nuclide numbering schemes.

Data file [27] - .OPEDID.DATA(PFC3FX) :
Data file [28] - .OPEDID.DATA(PFC3C18X) :
Data file [29] - .OPEDID.DATA(PFC3MX) . These differ only slightly from the equivalent data files - [7], [8] and [9] - from the 'iterative condensation' block. There is only a single rod absorber material, region name 'AHOMO'. The condensation is to 18, not 7, groups.

6.5.7 **Hand Edit**

Data files used in the above CITATION calculation are edited to provide data for the following CITATION. The only changes made are to the material region names - exchanging them for the equivalent 'Doppler' variants from the foregoing SLAROM calculation. The files affected are as follows:

.OPCITD.DATA(PFC3N70X)	→	(PFC3N70D)
.OPEDID.DATA(PFC3FX)	→	(PFC3FD)
.OPEDID.DATA(PFC3C18X)	→	(PFC3C18D)

6.5.8 **CITATION, 'Doppler'**

This is almost the same as the previous CITATION calculation. The main difference is that the data used is for the 'Doppler' state; also, the 'MICRO' step of the JOINT part of the calculation is omitted.

A batch job, run by JCL file [22].

The calculation uses as input the 70-group macroscopic nuclear data file .@GDI1P.PDS70G created by the earlier SLAROM calculation. Also used are the 3 data files created by the foregoing Hand Edit: geometric 'CITATION data' in file .OPCITD.DATA(PFC3N70D); flux extraction data in file .OPEDID.DATA(PFC3FD); condensation data in file .OPEDID.DATA(PFC3C18D).

Output from the CITATION step, to be used by JOINT, is placed in the internal file designated &&CIT. Temporary file .@GDI1P70.FLUXD holds the fluxes extracted from the bulk of CITATION output. The condensed nuclear data, in SLAROM (PDS) format, is output in temporary file .@GDI1P18.PDSMICD.

6.5.9 **PDSDUMP calculation**

A short program that extracts data from PDS format nuclear data files, in this case fission spectrum data. This is the same as the PDSDUMP calculation of the 'Rod Worth' block.

A batch job using JCL file [18].

Data is input as a PDS nuclear data file, that created in the foregoing 'normal' CITATION calculation - .@GDI1P18.PDSMICN .

6.5.10 **PERKY Package calculation**

This was provided to me as a pre-assembled JCL script, which linked a CITATION calculation of direct & adjoint fluxes with PERKY calculations of density perturbations for fuel, coolant and structural core materials. A pre-processor links the various data files together, and a post-processor calculates values of material density reactivity coefficients.

A batch job using JCL file [23]; the JCL includes one data line with 3 values that specify a n.d. dataset to be used -

field 1 No. of cycle used (final cycle in CITDENS)
field 2 Step within cycle: 1/2/3 - BOC/MOC/EOC (cycle > 1 year); 1/2 - BOC/EOC (cycle < 1 year)
field 3 (same as field 2)

Various 18-group nuclear data files created in the foregoing CITATION calculations are used -

.@GDI1P18.PDSMICN PDS format, 'normal' state
.@GDI1P18.PDSMICD PDS format, 'Doppler' state
.@GDI1P18.MICRON binary format, 'normal' state.

File .@GDI1.DENS is the number density dataset created by the CITDENS calculation of the 'basic fuel cycle' block; file .@GDI1.CITDAT is the temporary data file used in the same CITDENS calculation [file renamed from .PQINT.DATA(CIT)].
A whole series of further input data files are required. There are data files [30], [31], [32] and [33]. Delayed neutron data, in 18 groups, is input in a binary file - .DELAY.DATA - which is a copy of a standard section data file (a fixed data file). Three files of post-processor control data are input - .PQINT.DATA(POFUL) , (POSTR) , (POCOL) - consisting of:

line 1 value 2/3/4 indicating fuel/structure/coolant
line 2 value 1

Data file [30] - .OPEDID.DATA(NAMEF#XX) - gives the name of each material zone in order, first for the 'normal' state, then those for the 'Doppler' state.

Data file [31] - .OPEDID.DATA(IDNUMXX) - gives the PENCIL ID no. then the SLAROM ID no. of all nuclides in the nuclear data sets.

Data file [32] - .OPEDID.DATA(CHIMG) - gives the 18-group fission spectrum data from the previous PDSDUMP calculation.

For each fissioning nuclide (i.e all actinides with non-zero n.d.) -

nuclide ID no. (SLAROM version)

fission spectrum (18 values)

End with value 0.

Data file [33] - .OPEDID.DATA(ZONE#XX) - defines the zones for which the perturbation results are output.

Line 1 title line (do not alter)

Line 2+

field 1	CITATION ID no. of 1'st of a consecutive set of 'volumes'
field 2	CITATION ID no. of last of a consecutive set of 'volumes'
field 3	title given to this zone (used in output)

Note that, as originally supplied, the PERKY package also included calculations of Doppler, Na void, beta-effective and neutron lifetime. I deleted the sections that carried out these calculations, the 3 reactivity coefficients being all I required from this calculation (note that this calculation would be inadequate for calculating Na void, because of the use of only 18 groups).

6.6 3D Burn-up block

6.6.1 S-J-C Calculations

It is up to you whether you use S-J-C as a quick route to find approximate values for BOC and EOC rod insertions that give balanced ratings and the required Keff value. The calculation will be virtually identical to the S-J-C calculation in the 'basic fuel cycle' block, with JCL taken from the JCL file [7]. The only difference is that the 'CITATION data' file .OPCITD.DATA(PEE1D700) (data file [11]) has to be changed. The data file only requires a minor modification, altering block '005' to change the rod insertions. (It may also be necessary to modify blocks '004' and '005' to insert extra axial layers, to allow rod insertions to flux meshes that don't correspond to material zone boundaries.)

6.6.2 Hand Edit

This produces data file [34] - .OPMOSD.DATA(GDI1MBRN) - the input data file for the following 3D burn-up MOSES

calculation. It is basically the equivalent data file from the 'rod worth' MOSES calculation - data file [24] - but with the following changes.

A burn-up, rather than a steady state, calculation.
The same as the PENCIL calculations, models repeated irradiation/ refuelling cycles until it approximates to fuel cycle equilibrium. Individual S/A refuelling batches are modelled explicitly.
Use the highest level of symmetry possible, to reduce calculation time - in this case 120° symmetry.
Note some changes to iteration control parameters NITR, NIIT and EPSF, to values suited to transients.
Each irradiation step is a half cycle, DELDAY - BOC to MOC, then MOC to EOC.
In AXIAL and ASYGROUP, each rod insertion to be used defines a separate S/A type; each fuel S/A type is defined twice - the 1'st time is used for the original loading, the 2'nd time for refuellings.
The axial mesh used for irradiated fuel is defined in AXIAL (all fuel S/As are originally of axially uniform composition).
The rod absorber material uses heterogeneous nuclear data.
In REACT1 & YIELD, the limitation on the number of entries meant that the burn-up chain could not include the full detail of minor actinides included in the PENCIL/CITATION calculations. A minimal series was adopted; fission product and ^{10}B reactions were included (the latter only in diluent in the fuel, not in absorber rods).
The number density data is for the clean core - hence only 1 dataset per core Pu enrichment zone. The values can be taken from the temporary CITDENS data file - .PQINT.DATA(CIT) - from the 'basic fuel cycle' block (the same file is used in the 'shutdown margin' block, renamed as .@GDI1.CITDAT).
The REFUEL & REFMAP data define 6 sets of S/A loadings. First is the initial core loading (note the different S/A types c.f. later loadings). The 2'nd loading alters just the main rods, setting them to EOC insertions. The remaining 4 loadings each represent the refuelling of 1 of the 4 explicit fuel batches; rods are also moved to BOC positions.
After the PLANT & CRPOS data, a whole series of further calculation steps are defined; the calculation has a total of 9 cycles to reach equilibrium and then allow one cycle for each batch. There are 3 steps per cycle:

(1) refuel/initial loading (rods to BOC positions)
flux calculation (BOC)
burn-up calculation (BOC to MOC).
(2) move rods to EOC position [LOADING 2]
flux calculation (MOC)
burn-up calculation (MOC to EOC).
(3) (no loading) [LOADING 0]
flux calculation (EOC)
(no burn-up) [DELDAY = 0.0].

One set of REUEL & REFMAP data can be used repeatedly, by re-using the appropriate ID number in LOADING. Note that parameters are always as in the previous calculation step, unless overwritten.

6.6.3 **MOSES calculation**

A transient consisting of repeated burn-up and refuelling until fuel cycle equilibrium is approach (the same as the earlier PENCIL calculations). This pseudo-tri-Z model provides a reasonably accurate assessment of peak pin ratings.

A batch job using JCL file [24]. Compared with the 'rod worth' MOSES calculations, the JCL parameters N10, NX, NS are increased to accommodate the larger files needed by the transient calculation - all file size parameters of this type depend on the model size.

Input is the 'MOSES data' file [34] created in the above Hand Edit.

File .OBHZHBC7.MIC7GJ3 is the 7-group microscopic nuclear data file created in the 'iterative convergence' block.

The calculation is repeated as necessary, to adjust the BOC & EOC rod insertions to give both flat radial rating profiles and acceptable values of Keff (the latter is none too important, because of uncertainties in Keff associated with 7-group nuclear data).

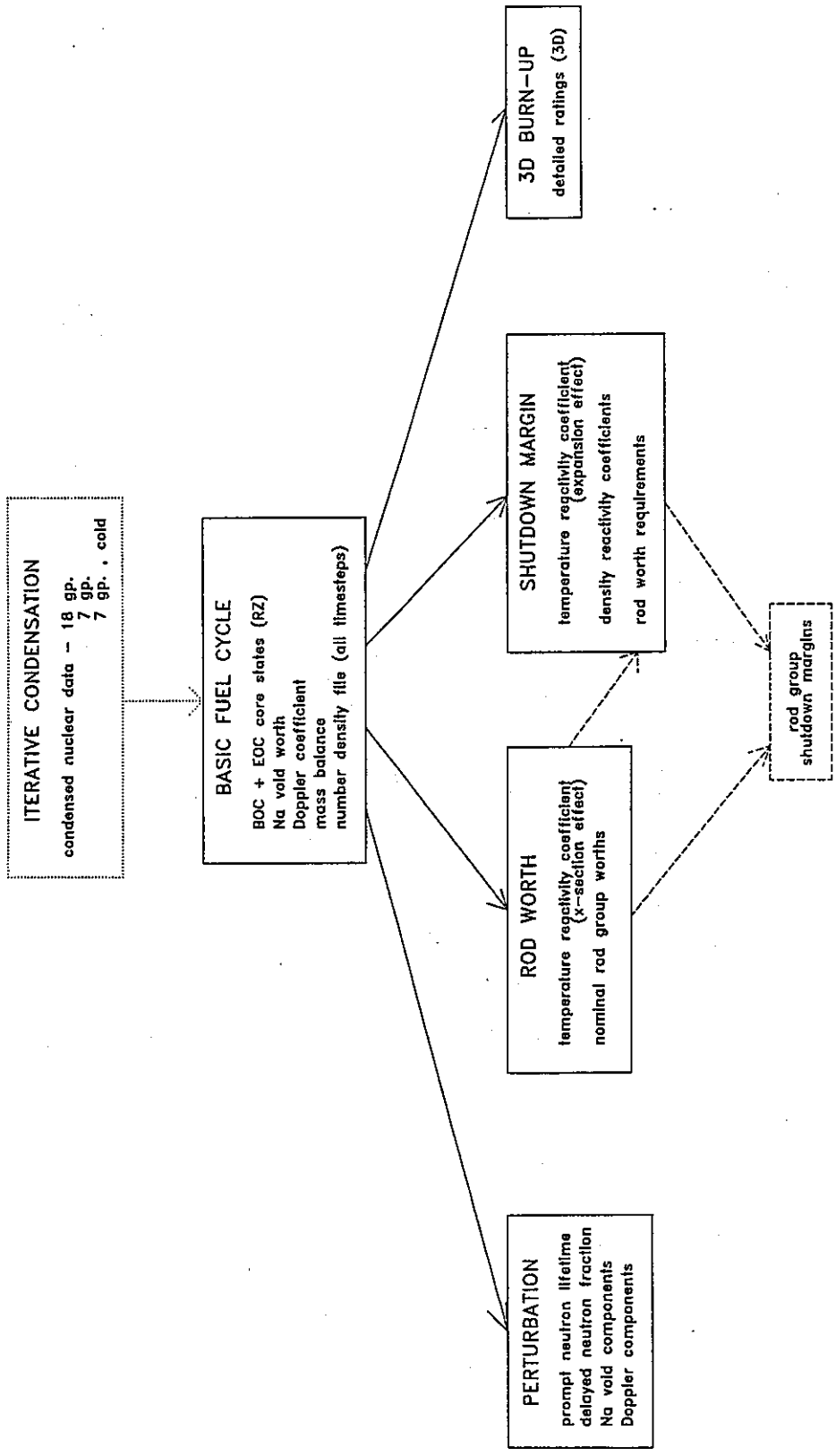

Figure 6.1 Calculation route, with parameters and major data items created by the separate blocks

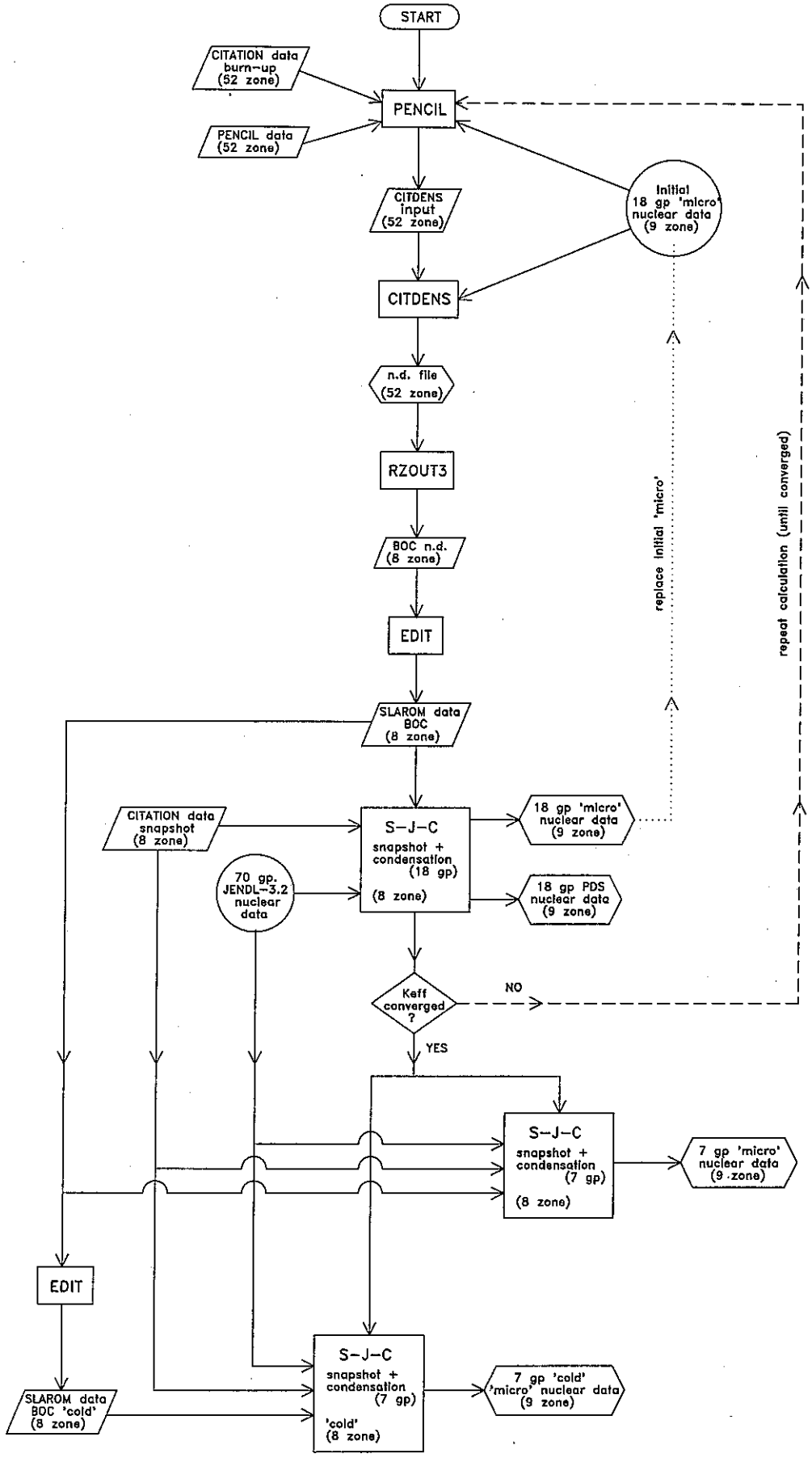

Figure 6.2 Schematic diagram - Iterative Convergence

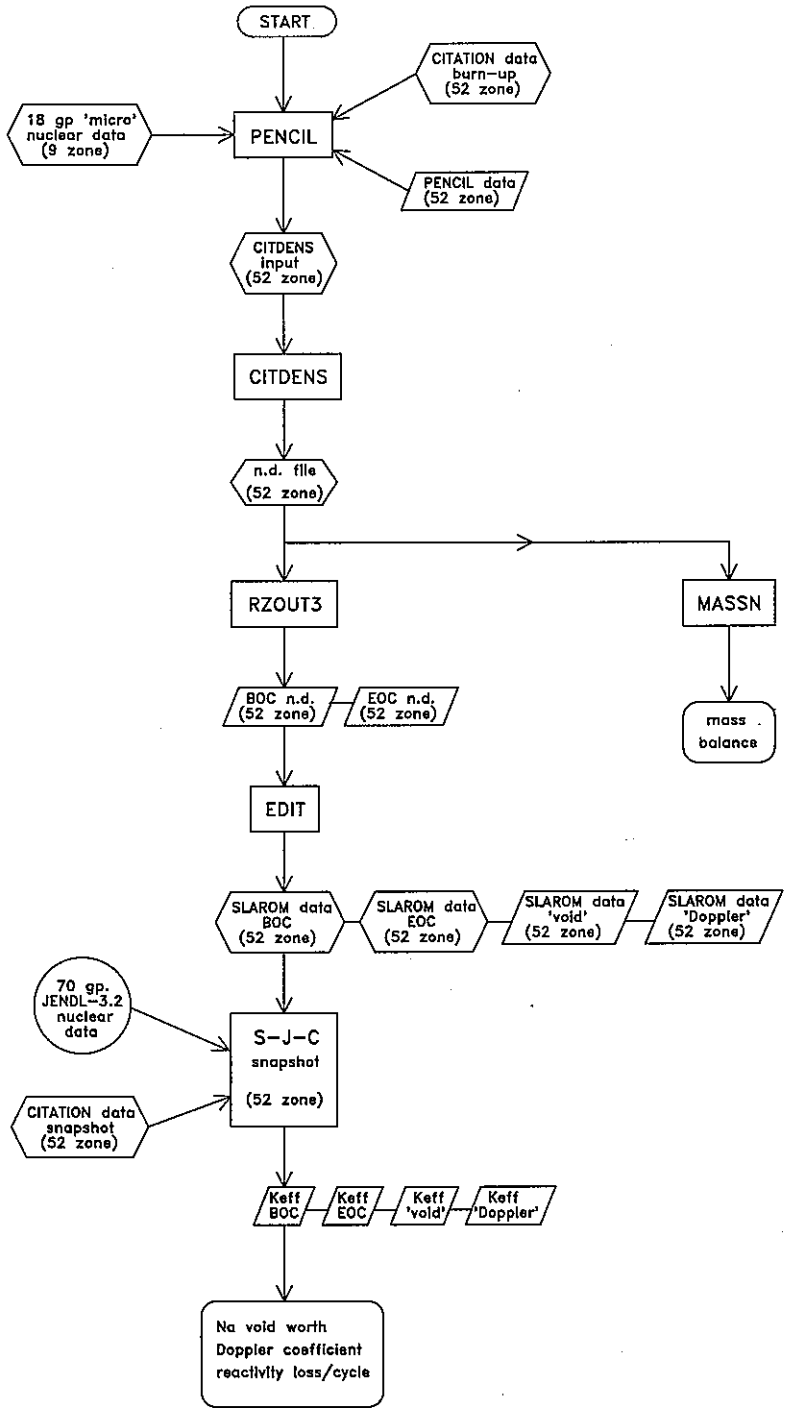

Figure 6.3 Schematic diagram - Basic Fuel Cycle

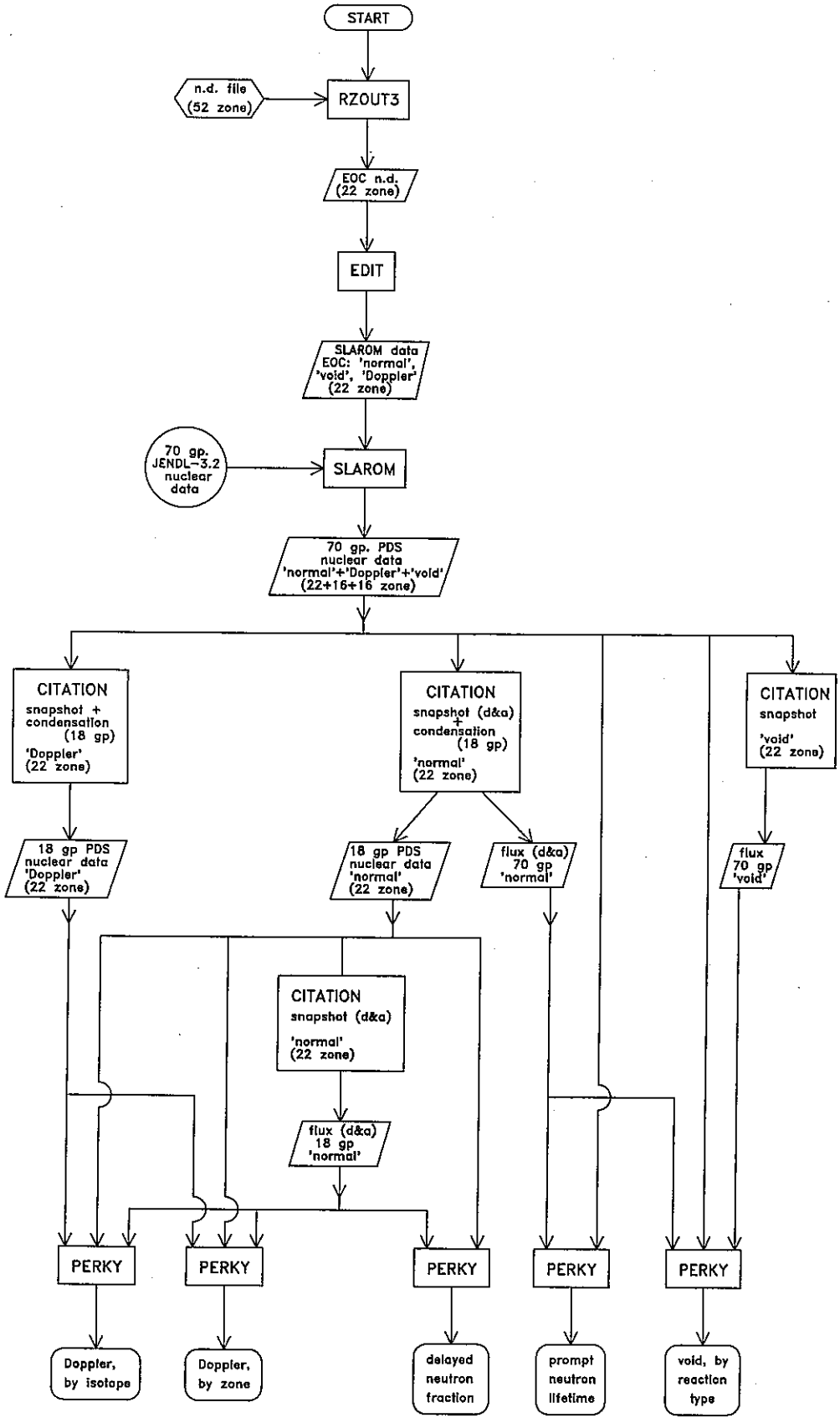

Figure 6.4 Schematic diagram - Perturbation

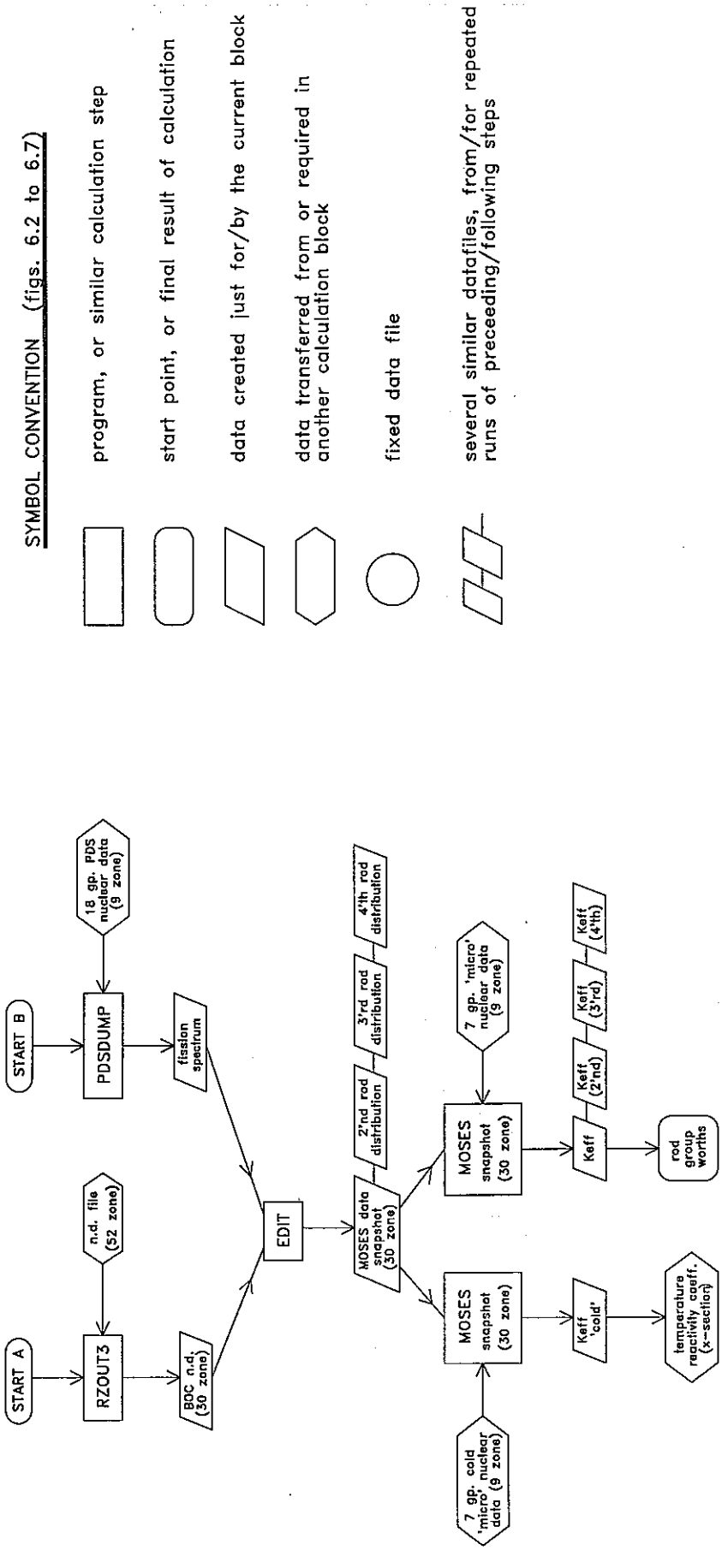

Figure 6.5 Schematic diagram - Rod Worth

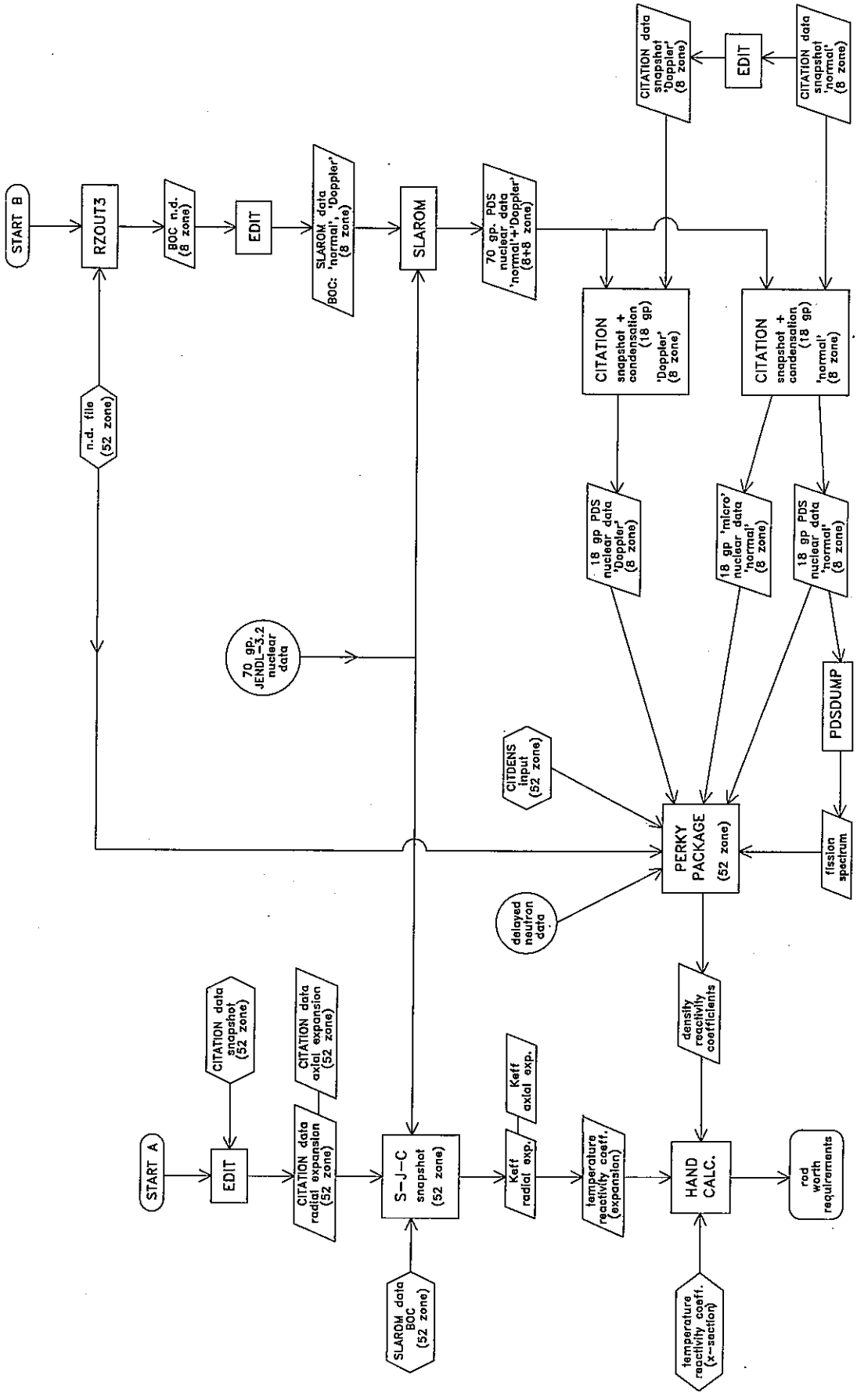

Figure 6.6 Schematic diagram - Shutdown margin

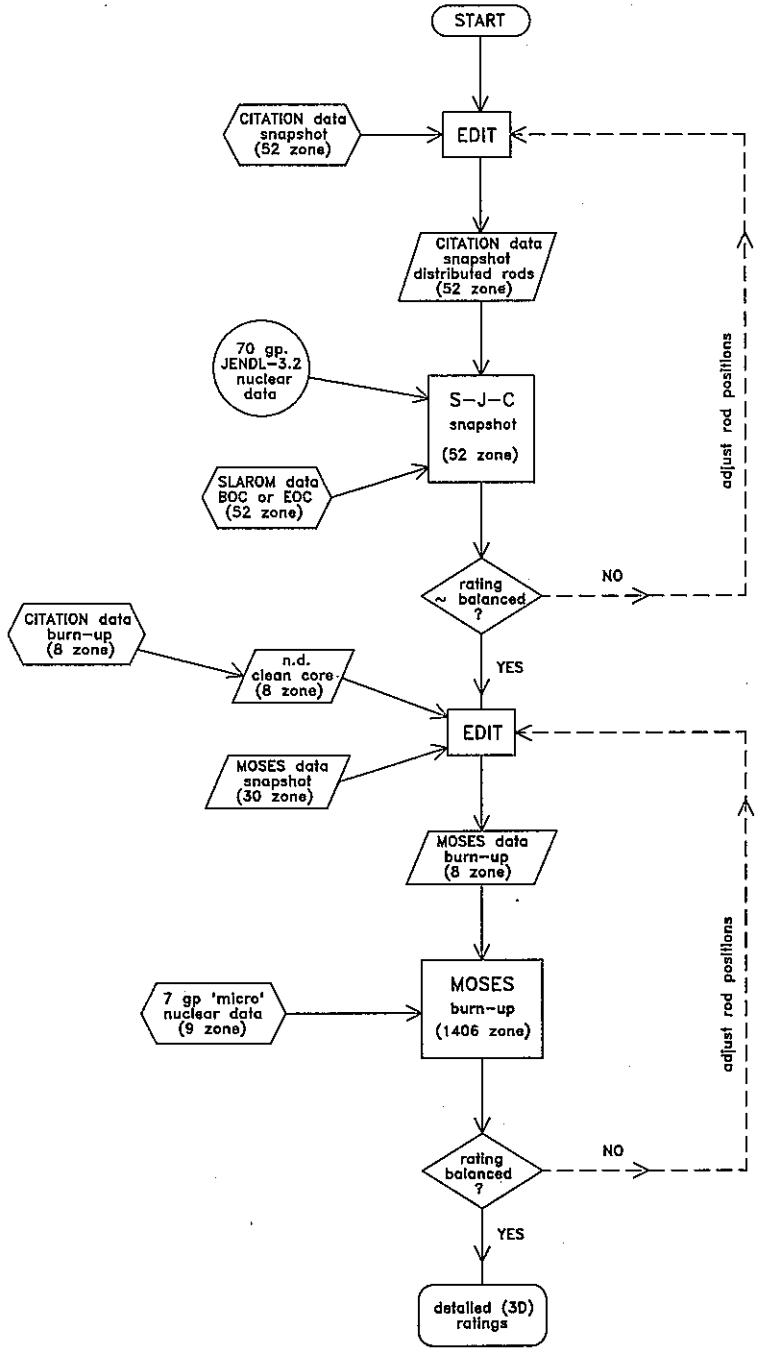

Figure 6.7 Schematic diagram - 3D burn-up

7 The Calculational Route - Future Modifications.

Concurrent with the production of this description of the calculational route, a number of computer programs are being written to update the route. These programs will have no impact on the structure of the calculational route, simply replacing steps in the route as described above.

Two programs, EDSLA[3] and EDMOS[7], will be available to replace the Hand Edit steps that take the number density data extracted by the RZOUT3 program and transform it to the formats required by SLAROM and MOSES, respectively. These programs will be advantageous in removing processes that are time-consuming (and potentially error-prone), especially when the 2-region fuel model is used in SLAROM. User guides are being produced for these programs[3,7].

A modified version of the MASSN program is being produced. The main change is that it will have the flexibility to handle cores with more than 2 core and breeder zones (such as BN600) with varying numbers of irradiation batches. A user guide is being produced[4]. [To allow the full calculational route to handle such cores, PENCIL will also have to be modified - this has yet to be attempted.]

Appendix I - PENCIL input data

VARIABLE	VALUE	DESCRIPTION
LAST	(max 30)	No. of Pu enrichment iterations. +ve/-ve - power plot output is core+axial blanket/core; 0 - just calculates N.D.s , no CITATION
PURICH (i≤2)		inner/outer Pu enrichments, (w/o) (initial guess, if LAST>1)
LPOWER	[430]	pin rating limit, W/cm (0.- not used)
TPOWER	[2600]	reactor power, MWth , assumes fixed thermal efficiency (EPOWER*26) (only 1 of this and EPOWER needed)
EPOWER	[100]	reactor power, 10's MWe , ignored if TPOWER used (TPOWER/26)
DAY(i≤3)	[365;3;4]	cycle length (days); No. of batches for fuel; No. of batches for radial blanket [max. of last 2 is basis for no. of cycles calculated, overriding value in CITATION input file]
COREH (i≤6)		axial height (cm) of each core zone (from top to bottom) [I used 8 axial zones, without problem]
ICZ(i≤24)		zone no's of inner core
OCZ(i≤24)		zone no's of outer core
ABZ(i≤24)		zone no's of axial blanket
RBZ(i≤24)		zone no's of radial blanket
IBZ(i≤24)		zone no's of internal blanket, (can be any position)
NUID (i≤99)		map of isotopes present in core (0 - absent; i - present)
F(i≤20)	[1;1; .94734;4*0] 7 gps [7*1; .8068;10*0] 18 gps	map of which energy groups are used in output flux values (usually limited to 100 kev) (does not affect calculation)
BOND	[0]	can filled with 0/1 - He/Na
DUCTLS (i≤3)	[0;6; 1.19277]	i=1, 0/1 with/w'out S/A wrapper i=2, no. of tie-rod pins } only if i=3, pin pitch/pin diameter} i=1 is 1
RONA	[.849052 @ 430 C]	Na density (g/cc)
ICNROD	[0]	0 - rods always out; 1 - split cycle in 2, rods 50%/0% in, needs full height model (see CITATION for rod movement)
DFUEL		fuel pellet outer diameter (mm) [only 1 of this & SMEAR needed]
DCLAD		pin clad outer diameter (mm)
DWIRE	[1.5/radial blanket 1.0]	wire diameter (mm)
HWRAP	[4.0]	S/A wrapper thickness (mm)
HCLAD	[0.4]	pin clad thickness (mm)
HWIRE	[165.0]	wire spiral repeat axial height (mm)

ITYPE	[0]	fuel pellet material type 0-MOX, 1-metal, 2-carbide, 3-nitride (not all fuel types can run all other options e.g. Minor Actinides)
TVERM	[1.98/2.0 core/radial blanket, or 0.11111, or 1.0, or 1.0]	fuel composition: metal Zr:M (w/o); O:M , C:M , N:M (a/o)
PUABND (i≤6)	[.58;.24;.14;.04;0.;0.]	Pu vector: 239,240,241,242,238,Am241 (w/o)
UABND (i≤2)	[.003;.997]	U vector 235, 238 (w/o)
NOPIN	[271/radial blanket 217]	Number of pins per S/A; includes ZrH diluent pins, and tie-bar pins in ductless fuel, as well as fuel pins
DGAP	[6.0]	gap between adjacent S/As (mm)
PRING	[0.177/ radial blanket 0.109]	parameter (mm) that defines the fraction of free space (x-sectional area) within a S/A (pins considered solid) - note this is supplied in lieu of S/A a/f dimension
SMEAR	[see table]	fraction of pin internal volume (x-sectional area) occupied by pellet - note this gives any inner pellet hole diameter [ignored if DFUEL used]
THDENS	[see table]	fuel pellet material, fraction of theoretical density
VSUS(i≤5)	[.6097;.1505;.1950;.0251;.0197 - SUS316]	composition of general structural material, w/o (Fe, Cr, Ni, Mo, Mn)
ROSUS	[7.969906]	density of above material (g/cc)
VSUS2 (i≤20, j≤3)		define up to 3 'special' structural materials j=1/2/3 - pin/wrapper/wire, 5 isotopes as VSUS, plus W, then 15 dummy values (set 0?) Do not use VSUS
ROSUS2 (j≤3)		densities of up to 3 'special' structural materials (g/cc) Do not use with ROSUS & VSUS
TRRICH		fraction of transuranics (TRU) in the fuel pellet (w/o) (represents extra material added for MA burning)
TRU(i≤17)		composition (w/o) of TRU : 235U,236U, 238U,237Np,239Np,238Pu,239Pu,240Pu, 241Pu,242Pu,241Am,242Am,243Am,242Cm, 243Cm,244Cm,245Cm
ITRU		definition of TRUO2 fraction: 0 - TRUO2/(TRUO2+UO2+PUO2) 1 - TRUO2/(PUO2)
RERICH		amount of rare earth (RE) as fraction REO2/(TRUO2) (w/o)
REA(i≤22)		RE isotopic composition; numbers 36,37,...,56,57 - any not present replaced by 0, PENCIL nuclide ID's
SZRH		fractional smeared density of ZrH inside clad

VB4C		fraction of pins that are unfuelled and contain B4C cannot be used in same case as VACR
B10W		fraction (w/o) of 10B in B4C
IBASE		type of inert matrix mixed with PuO2 in fuel pellet: 0 - UO2, 1 - MgO, 2 - CeO2, 3 - BeO,4 - Al2O3, 5 - ZrH2, 6 - AlN
VACR		allows a fraction VACR of a 'special' material, defined in ACRND, to be mixed with the fuel. (v/o) Cannot be used with VB4C or NZRH
ACRND (i≤99)		isotopic N.D. vector (PENCIL nuclide order) of 'special' material of VACR. Cannot be used with VB4C or NZRH
NZRH		No. of fuel pins that are unfuelled and contain ZrH Cannot be used with VACR
ZRH	[1.6]	composition of ZrH, ratio H:Zr
CPW	-0.97	target inner:outer peak rating ratio -ve - EOC inner : BOC outer +ve, ~1 - EOC : EOC +ve, ~100 - BOC : BOC (% value, not ratio) 0 - fixed inner:outer Pu % ratio
CKEFF	1.0048 [.996894]	target Keff for EOEC
EPW	0.002 [0.01]	allowed error on CPW
EKEFF	[0.001]	allowed error on CKEFF
PR	[0.3]	parameter to control change in Pu enrichment each iteration (%)
PTOK	[0.2]	similar to PR

[] indicates a default value.
Note - whilst values are stated as w/o (weight percent), there appears to be some confusion as to whether all such cases are actually percentages or fractions.

Additional Default Values

	MOX		Metal Fuel		Carbide Fuel		Nitride Fuel	
	core	blanket	core	blanket	core	blanket	core	blanket
SMEAR	0.876	0.908	0.750	0.800	0.850	0.900	0.850	0.900
THDENS	0.920	0.945	1.000	1.000	0.950	0.950	0.950	0.950

There are 3 different parameters that can be used for adding diluent material within fuel pins: VACR, VB4C and NZRH. Only NZRH and VB4C may be used in combination. There were errors if any 2 of these parameters were used (and whenever VB4C was used) - to avoid these make sure that the corrected load module is used
POC3A12.PENCIL52.LOAD(PENCIL).
NZRH replaces that number of fuel pins with ZrH However, the VACR and VB4C parameters just add extra material - so

if it is to replace fuel, then the amount of fuel must be reduced (using the THDENS parameter). VACR adds material at the number densities given in ACRND (i.e. the VACR value is irrelevant). VB4C adds that fraction of the fuel volume as B_4C - it uses the fuel volume after it has been reduced using THDENS (and after any reduction for NZRH).
(Note - if VACR is used including a nuclide already in the model - fuel or steel - then you should test the program to see whether the VACR material is treated as additional material or overwrites the existing value.)

The PRING parameter is calculated as follows:

$$B = 2.(N-1).(D+d).\cos 30^\circ + D + 2.d$$

and $$PRING = (E-B)/N$$

where
- E hexagonal a/f distance inside wrapper
- B hexagonal a/f distance of compacted pin bundle
- N number of pin rings
- D pin diameter
- d wire diameter

Nuclide ID schemes

Nuclide	PENCIL ID	SLAROM ID	Nuclide	PENCIL ID	SLAROM ID	Nuclide	PENCIL ID	SLAROM ID
^{239}Pu	1	949	^{235}U-fp180	30	854	^{209}Bi	59	83
^{240}Pu	2	940	^{241}Pu-fp180	31	814	(Mg)	60	12
^{241}Pu	3	941	^{246}Cm	32	966	(Y)	61	39
^{242}Pu	4	942	^{247}Cm	33	967	(^{101}Ru)	62	441
^{241}Am	5	951	^{248}Cm	34	968	(^{102}Ru)	63	442
^{235}U	6	925	^{99}Tc	35	439	(^{103}Ru)	64	443
^{236}U	7	926	^{139}La	36	579	(^{129}I)	65	539
^{238}U	8	928	^{140}Ce	37	580	(^{135}Cs)	66	555
^{16}O	9	8	^{142}Ce	38	582	^{10}B	67	105
^{23}Na	10	11	^{144}Ce	39	584	^{11}B	68	115
Fe nat.	11	26	^{141}Pr	40	591	^{14}N	69	147
Cr nat.	12	24	^{143}Nd	41	603	H	70	1
Ni nat.	13	28	^{144}Nd	42	604	He	71	2
Mo nat.	14	42	^{145}Nd	43	605	Be	72	4
^{55}Mn	15	25	^{146}Nd	44	606	^{27}Al	73	13
^{238}U-fp180	16	884	^{148}Nd	45	608	(^{6}Li)	74	36
^{239}Pu-fp180	17	894	^{150}Nd	46	600	(^{7}Li)	75	37
^{12}C	18	6	(^{147}Pm)	47	617	W nat.	76	74
^{15}N	19	157	^{147}Sm	48	627	Ca	77	20
Zr nat.	20	40	^{148}Sm	49	628	^{238}U-fp1080	78	887
^{237}Np	21	937	^{150}Sm	50	620	^{239}Pu-fp1080	79	897
^{239}Np	22	939	^{152}Sm	51	622	^{235}U-fp1080	80	857
^{242m}Am	23	950	^{151}Eu	52	631	^{241}Pu-fp1080	81	817
^{243}Am	24	953	^{153}Eu	53	633	^{238}U-fp1800	82	889
^{242}Cm	25	962	^{154}Eu	54	634	^{239}Pu-fp1800	83	899
^{243}Cm	26	963	^{154}Gd	55	644	^{235}U-fp1800	84	859
^{244}Cm	27	964	^{156}Gd	56	646	^{241}Pu-fp1800	85	819
^{245}Cm	28	965	^{158}Gd	57	648			
^{238}Pu	29	948	Pb nat.	58	82			

Appendix II - CITATION input data

Input is in a series of blocks, the first card of which is the block identifier. There is fixed format. Where blank lines occur these must be of exactly the correct number. Blocks '002', '018', '034', '036', '091' and '093' are only used for burn-up calculations.

```
block '001' - control options
card 2,    field 1 :  0/1 - snapshot/burn-up calculation
           fields 5-8 :  +1, write macro./flux/power/source
                         results file (to unit 31/9/32/
                                                      17).
           field 19 :  if >0 only uses block '008' macro.
                                                      data
card 3,               options for what results are output

block '002' - burn-up control
card 2,    field 1 :  No. of burn-up cycles to be calculated
                      (in PENCIL calculation, overwritten by
                      value from geometry data)
           fields 2-4 :  max. no. of burn-up timesteps per
                                 cycle (1'st,2'nd,3+ cycles)
           field 5 :  +1/-1, do normal/normal+adjoint flux
                                    calculations at each EOC
cards 3+4,            lengths of cycles (days), reactor
                      power MWth (power of core fraction
                      represented)
card 5,               options for what is output during
                                                      burn-up

block '003' - flux calculation definition
card 2,    field 5 :  geometry type (7-RZ, 13-hexZ, 14-triZ)
                         (only used RZ, suggested 3D would
                          be too time consuming)
           fields 8+9 :  symmetry flags
           fields 11-16 :  0/1 extrapolate/reflect boundary
                          conditions (left/top/right/
                          bottom/front/back)
           field 18 :  if >1 , allows -ve flux
card 3,               convergence criteria
card 4,    field 3 :  reactor power MWth (for snapshot
                         calc.) default is 1 MW

block '004' - geometric mesh (RZ geometry)
Radial then axial mesh data.  No. of meshes followed by
total size of those meshes.  Produces meshes of equal size,
radial ones correspond to equal areas.  Defines the
'volumes' where macroscopic x-sections are constant  {Does
not distinguish between hot & cold dimensions - the
dimensions & N.D. data are used as input, without applying
any expansion effects.}

block '005' - zone placement (RZ geometry)
A 'map' assigning a 'zone' number to each of the 'volumes'
of data block '004'.  Several 'volumes' may be in the same
'zone'.  Each 'zone' number identifies a material type
(i.e. different set of macro. x-section data and/or a burn-
```

up mesh).

block '012' - zone identification
A series of cards assigning the source of micro. x-section data for each 'zone'.
fields 1+2 : 1'st & last Nos. of consecutive set of 'zones'
field 3 : number of 'sub-zones' (i.e. batches per cycle) for this material
field 4 : position on input nuclear data file of x-section data to be used
field 6 : reference no. identifying 'zone class'
('zone class' is used in the fuel management input)
field 7 : 0/-ve for burn-up/non-depleting 'zones'
field 8 : name of 'zone' (only used in output print)

block '018' - nuclide classification
Groups nuclides into several categories, used to lump together reaction rates in output.

block '020' - nuclide Number Densities
Data is provided for all 'zones' (except in PENCIL input the core 'zones' are not included - that data is produced by the PENCIL program).
card 2, fields 1+2 : 1'st & last no's of a set of consecutive 'zones'
card 3+ pairs of nuclide identifier no. & atomic density {atoms per cc $*10^{-24}$}
[Note, no space between fields.]

block '034' - decay constants and fission yields
See CITATION manual[2] for details. 1'st 2 cards are decay constants for 3 nuclides in core. Remaining cards are fission product yield (only necessary if standard data of micro. binary file is overwritten e.g. MA work). In each case the first card (2 values) are the 1'st and last sets of x-sections, on the micro. input file, to which burn-up is applied.

block '036' - nuclide reaction chain
See CITATION manual[2] for details. Specifies nuclide decay & reaction relations in the core. First 2 values are (again) 1'st and last micro. datasets to which burn-up applies.

block '091' - fuel stream description
The number and arrangement of fuel streams is arbitrary (i.e. user defined). Material is removed from the reactor at the end of irradiation to a 'discharge stream', it is mixed (after any reprocessing delay) with material new to the fuel cycle from a 'feed stream' - the resultant new fuel material is placed into the reactor as a 'makeup stream'.
cards 2+ field 1 : number of fresh material 'feed streams'
field 2 : number of new fuel 'makeup streams'
field 3 : number of 'discharge streams'

```
            field 7 :  number of cycles delay between
                         discharge and recycling in new fuel
            fields 9+ :  identifiers of nuclides to be
                                        treated in fuel streams
cards 3+    fields 1-3 :  nuclide identifiers of decay parent
                           & child, decay constant (sec-1).
Data for each 'feed stream'
cards 4+    field 1 :  'feed stream' identification no.
            field 2 :  0/1 - use initial loading/values on
                          cards 5&6, for 'feed stream' N.D.s
Data for each 'makeup stream'
card 7,     field 1 :  'makeup stream' identification no.
            fields 3-5 :  ID no.s of 'discharge streams' used
            field 6 :  ID no. of 'feed stream' used
            field 9 :  fraction of material available from
                           'discharge streams' to be used
cards 8+    for each nuclide on card 2, fraction of
            'recovered' material in 'discharge streams' to be
            used
Data for each 'discharge stream'
card 9,     field 1 :  'discharge stream' identification no.
cards 10+   for each nuclide on card 2, fraction of
            discharged material 'recovered' during
            reprocessing

block '093' - fuel management
card 2,     field 2 :  {uncertain of meaning, CITATION manual
                           description is unclear}
            field 4 :  no. of fuel cycles calculated
cards 6+    Each card specifies one 'fuel movement'
            field 1 :  'identification no. of 'fuel movement'
            field 2 :  'feed stream' used for new fuel before
                          recycled material is available
                          (0 - 'closed loop', no refuelling)
            field 3 :  'feed stream' used in mass balance
                          calculation
            field 4 :  'makeup stream' used for new fuel
                           after recycled material is available
            field 8 :  'discharge stream', destination of
                                                removed fuel
            field 10-12 :  cycle no. when this 'fuel
                           movement' ends (if <>0)/starts/
                           frequency of use
            fields 13+ :  'zone class' to which 'fuel
                           movement' is applied, if >1 value
                           is a shuffling through 'zones'
                           with defuelling from the last one
                           (a closed loop, no defuelling, is
                           possible); with 'sub-zones' only
                           1 'sub-zone' is moved each cycle,
                           in order {CITATION manual is
                           confused over 'zones' and 'zone
                           classes'}

block '999' - end of data marker
```

Appendix III - PERKY input data

Line 1 'PERKY' (program ID)
Line 2 1'st fuel material region; 'SLAROM' (creating program ID)
Title Line
Block '001' - general data
  Line 2
    field 2 no. of energy groups
    field 4 no. of material regions input (max 40)
    field 5 1/0 - RZ/XY or XYZ geometry
    field 6 1 if an exact perturbation calc. (else 0)
Block '002' - microscopic data input
  Line 3
    field 1 total no. of microscopic datasets input
    field 2 no. of microscopic datasets input by JOINT
    field 3 no. of microscopic datasets input by 2'nd input file (I have not used this option)
    field 4 no. of microscopic datasets input within this file (I have not used this option)
    field 5+ id. no. assigned to each microscopic dataset
  For each material region for which JOINT microscopic data is input:
    line 1 microscopic dataset ID no.; no. of isotopes with microscopic data input (max. 20)
    line 2 name of material region providing microscopic data; 'SLAROM' (creating program ID)
    line 3 ID no.s of nuclides for which microscopic data is input
  Last line Pairs of: material region ID no.; microscopic data ID no. of corresponding data (blank where no such data is input)
Block '003' - macroscopic data input
  Line 3+
    field 1 total no. of macroscopic datasets input
    field 2 no. of macroscopic datasets input by JOINT
    field 3 no. of macroscopic datasets input by 2'nd input file (I have not used this option)
    field 4 no. of macroscopic datasets input within this file (I have not used this option)
    field 5+ material region ID no. assigned to each macroscopic dataset
  Line 4 material region supplying fission spectrum data; 'SLAROM' (creating program ID)

```
      Line 5
           field 1    no. of energy groups
           field 2    no. of downscatter groups (max 30?)
           field 3    no. of upscatter groups
      Line 6+    for each material region providing JOINT
                 macroscopic data input: material region
                 name; 'SLAROM' (creating program ID)
Block '004'  -  calculation type
      Line 2     1 - delayed neutron fraction
                 2 - prompt neutron lifetime
                 3 - reactivity worth map
                 4 - 1'st order perturbation
                 5 - exact perturbation
Block '005'  -  delayed neutron data
      Line 2
           field 1    no. of energy groups
           field 2    no. of delayed neutron precursor
                      families
           field 3    no. of nuclides giving rise to delayed
                      neutrons
           field 4+   ID no. of each delayed neutron
                      producing nuclide
      Line 3     no. of energy groups
      For each delayed neutron producing nuclide:
           Line 1     nuclide ID; no. of delayed neutron
                      precursor families
           For each delayed neutron precursor family
                fraction of neutrons that are delayed (by
                energy group)
                energy spectrum of delayed neutrons
Block '006'  -  neutron lifetime data
      Line 2+    upper bound lethargy of each energy group
Block '007'  -  fission distribution data (I have not used
                                                        it)
Block '008'  -  perturbation data
      Line 2
           field 1    0/1 - microscopic/macroscopic data
                      used to define perturbed state
           field 2    1 for 'by nuclide' perturbation,
                      0 otherwise {meaning not certain}
           field 4    no. of material regions where
                      perturbation changes occur
           field 5+   ID no.s of material regions to be
                      changed
      Line 3     name of 1'st perturbed material region;
                 'SLAROM'
   'by nuclide' case
      Line 4
           field 1    no. of perturbed nuclides (max 10)
           field 2+   ID no.s of perturbed nuclides
      Line 5     ID no.s of burnable isotopes included in
                 flux calculation (max 10) {uncertain of
                 meaning}
      For each material region with perturbation changes
           line 1
                field 1    ID no. of normal microscopic data
                field 2    ID no. of perturbed microscopic
                           data
```

```
                field 3    no. of perturbed nuclides
                                                    (max 10)
          For each perturbed isotope
                field 1    ID no. of perturbed nuclide
  other cases
     Line 4     pairs of microscopic data or material
     region
                ID no.s: a normal dataset, followed by the
                perturbed version that replaces it
Block '999' - end of data marker.
     Followed by one blank line.
```

Note that the ID Nos. given to unperturbed microscopic datasets and material regions should correspond to the zone numbers in the CITATION calculation that produced the unperturbed flux file used in the PERKY calculation.

Note that the input of microscopic and macroscopic datasets via JOINT, and of delayed neutron data, is not as described in the (Japanese) PERKY manual[5].

Appendix IV - MOSES input data

The manual for MOSES is reference 9. It gives a fuller description of the input; unfortunately, it is only available in Japanese.

There are 2 input file names to be set to run a case -
- FT03F001 is a microscopic nuclear data file, in CITATION (binary file) format
- FT05F001 is the case input data.

Other input files, which I have not used, are -
- FT08F001 is used for debugging options
- FT69F001 is fuel shuffling data in refuelling sequences

If a case is large, then it may be necessary to alter the size of temporary workfiles used by the program (these have to be user specified!). There are a series of parameters such as N1, N2, NX etc. specified in the JCL - if a job fails due to insufficient space, look for the part of the output in the failed job where recommended values are given for these parameters.

Input is in a series of blocks, in order, each identified by a **KEYWORD** at its beginning. Some blocks are ended by the words **EOI** or **EOB**. Input is in free format.

Title Starts with 2 title lines (no 'TITLE' keyword).

CONTROL Calculation type - Steady State or Burn-up.
6 values (0/1). Set just the first 3 values to 1 for a diffusion calculation, all 6 for burn-up.

EDIT Output option control.
4 sets (lines) of integer values.
[Details not known.]

EDITD Detailed S/A output control.
3 sets each of 50 values. No.s of S/As for which detailed output is produced; for diffusion, burn-up and N.D. calculations.
Will give data for peak S/As anyway (with standard **EDIT** values).

EOB

LOADING Core loading/refuelling step selector.
The ID number of a core S/A map dataset from **REFMAP**. The S/As specified by this dataset will be loaded, unloaded or both, as specified by **REFUEL** (can be e.g. full core description or a refuelling step). (0 for a calculation step with no change in core layout.)

GEOM Basic geometric data -

NSYM symmetry - no. of 60° sectors modelled (1,2,3 or 6); the symmetry is rotational.

NLAY	no. of S/A rings in model
NPLN	no. of axial planes (mesh centred flux) (supposedly limited to 40, but have used larger number without problems)
NAZN	no. of axial material regions. Defines where axial boundaries in material compositions are allowed. {supposedly max 14, but I accidentally used 15, without any apparent error}.
NGRP	no. of energy groups
PITCH	hexagonal mesh a/f pitch (cm)
MESHZ	no. of uniform flux meshes in each axial material region (NAZN values, adding up to NPLN).
DELTZ	height (cm) of each axial region (NAZN values)

CPARA1 Calculation type and time step control -

NMES	1 - 1 hex mesh per S/A; 2 - 1 hex mesh per S/A, interpolated to 6 rating (not n.d.) meshes per S/A (Askew method); 3 - 6 meshes per S/A.
NCAL	0 - direct flux calculation; 1 - direct & adjoint fluxes calculations; 2 - source calculation.
NITR/NIIT	no. of outer/inner iterations. (For NMES=3, try increasing NIIT from the default 3 to 8.)
NTIM	flux solution curtailed after this many seconds CPU time
8 values	(not to be used)
DELDAY	burn-up time (days) for this calculation step
NSMALL	number of sub-steps a burn-up calculation step is divided into (flux is re-evaluated each sub-step)

CPARA2 Calculation convergence control -

EPSRMD	Keff convergence limit (have reduced to 5.0e-6)
EPSF	flux convergence limit (have reduced to 1.0e-4)
EPSMIN/EPSMAX	extreme Keff value bounds (use default values, 0.5/1.5)
METHOD	burn-up calculation method. (Option 1 always used.) 1 - 'matrix exponential' 2 - 'average generation rate'.
8 values	(not to be used, only for METHOD=2)

EOB

AXIAL S/A axial composition data.
Defines an axial map of material types onto axial regions; boundaries only allowed where already set by DELTZ. These regions also define the axial n.d. mesh in a burn-up calculation. For each S/A type to be used in the model (max 40) -

line 1	NREGZ, followed by NREGZ values of material type ID
line 2	NREGZ values of axial region height (sum equals sum of DELTZ values)

End with **EOI** marker.

{In earlier calculations, I had problems when I used

NREGZ=14 axial zones in a model with NAZN=14. This was a program bug, now corrected - errors were apparent when checking the axial map of S/A materials in the MOSES output.}

ASYGROUP S/A output data.
For each of the S/A types of **AXIAL**, and in the same order, the following items -

field 1 1 - fixed; 2 - axially moving (an absorber rod). 'Axially moving' allows the use of **CRPOS** to reposition rod insertions between calculation steps
field 2 an ID number (max 15) used in the MOSMAP core map
field 3 0 or 1 (always use 1)
field 4 1 - inner core; 2 - outer core; 3 - radial blanket; 4 - shield, rods etc.
Used in print output.
field 5 if -ve then label 'field 6', rather than this value, is used in plotted output
field 6 S/A type ID label
field 7 S/A type name (used in output) - 2 separate words
End with **EOI** marker.

REGION Material type data.
For each of the material types (max 60) used in the S/A **AXIAL** mapping, the following -

field 1 position of entry on nuclear data file to be used for microscopic nuclear data
field 2 material type ID - used to define materials in some of the output, allows several to be combined
field 3 flag used to set printing option (*always use 1*)
field 4 1 - fuel; 2 - axial breeder; 3 - axial shield; 4 - radial breeder; 5 - radial shield; 6 - rods
field 5 flag used to set plot option (*always use 1*)
field 6 material type identifying label
field 7 material type name (used in output) - 2 separate words
End with **EOI** marker.

MICROXS Nuclear data (general).

NLIB source of nuclear data (always use 1 - FT03)
NSET no. of nuclear data entries in source file
NNUC no. of nuclides used in the MOSES calculation
NRAC no. of entries in nuclear dataset that include burnable nuclides (must these be the 1'st entries?)
NHAT thermal energy option: 0 - only fission x-sections 1 - capture & fission (2 - unknown, do not use)
NFGP no. of groups > 0.1 Mev (used in printout only)
CHI spectrum of neutrons produced by fission

XSNUC Nuclear data, for each of the NNUC nuclides -

IDNUC the nuclide ID number used in the nuclear dataset (i.e. PENCIL ID no.)
NAMNUC nuclide name, used in print output
IFIS fissile nature identifier: -1 - fission products; +1 - uranium; +2 - plutonium (inc. Am241);

	0 - others. Those set +1/+2 will have fission reactions included in the burn-up calculations. Defines materials for breeding ratio calculation.
NBURN	nuclide classification: 1 - fissile; 2 - fertile; 3 - other fuel nuclides; 4 - fission products; 5 - oxygen; 6 - coolant & structure; 7 - B4C; 8 - 'anything else'. Used to define materials for fuel cycle balance. MA are type 3, diluent type 6.
NANAL	always use 0
KLIB	if 1, use standard values of ATW & EFISS (rather than data input below); if 2 also use standard DECAY values
ATW	atomic weight
EFISS	energy per fission
ECAPT	energy per capture
DECAY	decay time constant

REACT1 Decay chain data. A series of lines with 4 values followed by a card with '0'. Max. no. of entries not specified; if too many are used, unflagged array bound errors can cause subtle errors (e.g. in Keff); appears OK with 19 entries. Was initially advised to include fission products producing themselves by neutron capture - seems dubious, since other isotopes are not needed here to make capture effective (not in MOSES manual example).

field 1	ID of nuclide undergoing reaction (IDNUC value)
field 2	ID of nuclide produced by reaction
field 3	reaction type: 1 - beta decay; 2 - (n,gamma); 3 - (n,alpha); 4 - (n,p); 5 - (n,2n); 6 - (n,d); 7 - (n,t); 8 - special, used when x-section library excludes the (n,2n) reaction (takes value 'field 4' x fission x-section).
field 4	fraction of reactions that are of this type, where more than one reaction product is possible

YIELD Fission product yield data.
A series of lines with 3 values on, all nuclides with IFIS > 0 must be included. As with **REACT1**, too many values cause array bound errors; it appears to work with up to 14 values, but am advized to use no more than 10 values.

IFP	ID of fission product nuclide (IDNUC value)
IFS	ID of a nuclide yielding fission product IFP
YIELD	fraction of IFS that end up as IFP

ATDEN Number density data. For each of the material types in **REGION**, and in the same order -
A list of number densities (atom/cc * 10^{-24}) for each of the nuclides in **XSNUC**, in the same order.
End with **EOI** marker.

BOUNDARY Boundary condition data.
One value for each energy group, for the radial, then upper, then lower boundaries. Default value

is 0.4692; normally use vacuum boundary, 0.0; reflective boundary is 1.0.

REFUEL Burn-up calculation fuel cycle balance data. Each line is associated with one set of input under **REFMAP**. Exactly 10 lines of input -

field 1 1/0 indicates fuel is/is not loaded
field 2 1/0 indicates fuel is/is not removed
field 3 refuelling step length (days) (not necessarily the same as calculation step DELDAY).

REFMAP Core loading/fuel movement S/A sets. Identifies S/As that are loaded and/or unloaded, according to **REFUEL** data, when a **REFMAP** set is invoked by **LOADING**. One set of data for each non-zero line under **REFUEL** (max 10 sets). Each set has a title line, followed by lines identifying a series of S/As -

I1 first of a series of continually numbered S/As
I2 last of a series of continually numbered S/As
K ID of S/A type assigned to positions I1 to I2 (For ease of input, later entries can overwrite S/A type IDs assigned in an earlier line.)
- there is final line containing values 0 0 0.
End with **EOI** marker.

PLANT

CPOWER reactor power (MWth). For NSYM<>6 this power must be reduced proportionately.
TIN reactor inlet temperature [not used in calculation]

CRPOS A series of sets of 40 values (1 for each S/A type allowed). Provided ASYGROUP(1)=2, indicates how far the rod positions are moved from those set in **AXIAL**. +ve values indicate upward movement; all material boundaries move, the top/bottom material is used to fill in any space created. Is not restricted to mesh positions defined in **GEOM**.

DBURNUP [Optional] Data for option to interpolate 1 mesh per S/A n.d. representation to 6 meshes per S/A, in selected S/As. OPTION NOT YET IMPLEMENTED IN MOSES.

ASMRC and FIXSRC [Optional] Neutron source data (I have not used this option).

EOB

Multiple cases, or a series of steps within a single burn-up calculation, are input by repeating the input data, including the TITLE and all EOB lines. It is generally only necessary to input keywords where values change,

though all values for that keyword have to be input. It appears likely that at least one keyword should be included for each **EOB** block - **CONTROL**, **LOADING** and **CRPOS** are the favourite candidates for permanent inclusion in the 3 blocks.

It should be possible to use either **CRPOS** or **REFMAP** to change rod insertions. **REFMAP** has the advantage that it does not move any detailed above/below core structure, all that is required is to have S/As for the different rod insertions defined under **AXIAL**, and to "refuel" the rod S/As.

The mesh representation gives values for flux, rating etc. at the centres of meshes. This even applies to the extrapolated 6 point values obtained using the Askew type calculation. (A proposed future version will produce values that are actual 'peak interpolated' values, rather than centre of triangle values.)

Sub-assembly numbering starts with 1 at the core centre, then each succeeding ring is numbered in order, clockwise. The initial S/As of each ring, together form a straight line of S/As, each sharing edges with its neighbours. There is an interactive program MOSMAP, which will take any MOSES input dataset and produce plots of the S/A layout (useful for data checking).

The MOSMAP command file - POC3C##.CMDPROC.CLIST(MOSMAP) - is listed in my Macro enabling file - .TSS.CLIST - which is invoked as described under the RZOUT3 calculation: at the command prompt input

```
STREAM COMMAND
EX TSS
LOGON
```

To start MOSMAP, at the command prompt just type MOSMAP - you are prompted for the data file name, this must be the full name path (since the MOSMAP procedure file is owned by another user). The output goes to a printer situated in an adjacent building (the building where, at present, Aoyagi-san works 3 days per week).

Appendix V - Core Expansion Reactivity Effect

The following analysis is that used for the Pu burner core[9], it was in turn based on that used for the PNC design study on a 600 MW(e) class reactor[10].

Two types of computer calculation are done to produce components of the thermal expansion effects on reactivity.

One calculation type is 1'st order PERKY calculations. These calculate the reactivity effects of density changes in the fuel, coolant and structural materials:

$$K_F = \frac{\Delta k / kk'}{\Delta \rho_F / \rho_F} \quad , \quad K_C = \frac{\Delta k / kk'}{\Delta \rho_C / \rho_C} \quad , \quad K_S = \frac{\Delta k / kk'}{\Delta \rho_S / \rho_S}$$

(Note that any diluent material goes in the structural category.)

The second type of calculation is CITATION calculations for the core, but with either axial or radial mesh sizes slightly increased (say 1%), the number densities remain the same. These calculate the reactivity effect of changes in core height and radius:

$$K_H = \frac{\Delta k / kk'}{\Delta H / H} \quad , \quad K_R = \frac{\Delta k / kk'}{\Delta R / R}$$

The thermal expansion effects have to be added to temperature effects in cross-sections to get the complete reactivity effect of changing reactor temperatures. The following shows how the core expansion reactivity effect is calculated from the above factors, which are produced by the 'shutdown margin' calculation block.

The various core components undergo different amounts of thermal expansion, the overall effect is obtained from summing the following 5 factors:

$$F_1 = \Delta T_{sup} \cdot \alpha_{steel}(T_{sup}) \cdot \left(K_R - 2 \cdot (K_F + K_S) + 2 \cdot \frac{(1 - V_{Na})}{V_{Na}} \cdot K_C \right)$$

$$F_2 = -\Delta T_{wrap} \cdot \alpha_{steel}(T_{wrap}) \cdot 2 \cdot \frac{V_{wrap}}{V_{Na}} \cdot K_C - \Delta T_{clad} \cdot \alpha_{steel}(T_{clad}) \cdot 2 \cdot \frac{V_{pin}}{V_{Na}} \cdot K_C$$

$$F_3 = \Delta T_{fuel} \cdot \alpha_{fuel}(T_{fuel}) \cdot (K_H - K_F)$$

$$F_4 = -\Delta T_{clad} \cdot \alpha_{steel}(T_{clad}) \cdot \frac{V_{clad}}{(V_{clad} + V_{wrap})} \cdot K_S - \Delta T_{wrap} \cdot \alpha_{steel}(T_{wrap}) \cdot \frac{V_{wrap}}{(V_{clad} + V_{wrap})} \cdot K_S$$

$$F_5 = \Delta T_{Na} \cdot \alpha_{Na}(T_{Na}) \cdot K_C$$

V - volume fraction
α - material thermal expansion coefficient, temp. dependent (density coefficient for Na coolant)

ΔT - temperature change
sup - support diagrid
wrap - wrapper
pin - all pins (including contents)

The support diagrid effects overall radial expansion (F1) - core radius increases, this also causes solid material densities to reduce; coolant fills the added volume. (Radial expansion is in 2 dimensions, hence the factor 2.)

Radial expansion within the S/A displaces some coolant (F2) - wrapper volume and pin volume (fuel & diluent) expand (pin expansion assumed driven by steel clad, not pin contents).

Fuel expansion effects overall axial expansion (F3) - assumed not stuck to clad, core volume increases, but fuel density decreases.

Axial expansion of non-fuel components (F4) - clad, wrapper and diluent densities reduce; diluent is assumed to expand with the clad. (Diluent set partly to each of the clad & wrapper temperatures - necessary to make equation tractable.)

Coolant density changes (F5).

As well as the calculations of PERKY and CITATION to produce reactivity/temperature coefficients, need to have values of expansion coefficients and of temperatures appropriate to the various materials. The following values were used for the Pu burner core[9], they were taken from the PNC design study on a 600 MW(e) class fast reactor, it may be appropriate to calculate replacement values -

Operating temperatures (°C)

support	380
coolant	455
wrapper	455
clad	475
fuel	1073

Cold shutdown temperature 200°C

Linear expansion coefficients ($\Delta l/l$ per °C)

fuel	1.439×10^{-5}
clad	2.016×10^{-5}
wrapper	2.003×10^{-5}
support	1.949×10^{-5}

Density expansion coefficient ($\Delta\rho/\rho$ per °C)

coolant	-2.841×10^{-4}

Appendix VI - Shutdown Margin Components

The calculations of the 'rod worth' block provide nominal values of the rod group worth for both the main (PCR) and backup (BCR) rod groups, from a difference in Keff values. To translate these to values of shutdown margins, it is necessary to apply allowances for uncertainties in the calculated rod worth values, and to compare the result with the shutdown requirements. The following lists the various components of rod worth uncertainty and shutdown requirements that are included in the PNC calculation route; the values used for the Pu burner core[9] are given below, they were taken from the PNC design study on a 600 MW(e) class fast reactor[10] - it may be appropriate for you to obtain a different set of values.

Components of Rod Worth Uncertainty

Effect Adjusted	Factor
Effect of Condensation to 7 energy groups	x0.972
Combined Mesh and Transport correction factor	x1.021
Control Rod Heterogeneity correction factor	x0.88
Rod ^{10}B Burn-up correction factor	x0.95
Difference between MOSES program and reference (CITATION) used in assessing corrections	x1.0
Adjustment for difference from experimental study (based on JUPITER core ZPPR-10C)	x1.018
Allowance for calculational uncertainty (2σ)	x0.9
Total Correction Factor	x0.761

Components of Shutdown Requirement

Components of Main Rod Group (PCR) Shutdown Requirement	
Effect of reducing reactor temperature to 200°C	α
Reactivity loss per cycle	β
Margin for control at EOC	0.2 %Δk/kk'
Margin for variations in refuelling batches	0.1 %Δk/kk'
Uncertainties in cycle length #	
Reactor measured power uncertainty (2σ)	0.24 %Δk/kk'
Fuel fabrication uncertainties (2σ)	0.3 %Δk/kk'
Uncertainty in reactivity loss/cycle (2σ)	20% of β
Uncertainties in shutdown margin #	
Uncertainty in calculated Keff (1σ)	0.44 %Δk/kk'
Fuel fabrication uncertainties (2σ)	0.3 %Δk/kk'
Components of Backup Rod Group (BCR) Shutdown Requirement	
Effect of reducing reactor temperature to 200°C	α
Margin for reactivity inserted during fault	0.2 %Δk/kk'
Uncertainty, based on JOYO measurements (2σ)	0.24 %Δk/kk'

components are combined in quadrature

The values of α and β are assessed for each use of the calculational route.
α is the combined reactivity worths of the core expansion (see previous addendum) and changing nuclear data.
β is obtained from the S-J-C calculations of the 'basic fuel cycle' block.

Appendix VII - Example Datasets

The following pages list the various JCL and data files referred to in Section 6 of this note. All the files should be available on the FACOM computer, under uid POC0B17 , if not immediately accessible then they are all available from my archive tape cartridges.

In the listings there are various line number fields given at the end (sometimes the beginning) of the lines - these can be ignored, they are an artifact of the FACOM file storage and editing system.

The following is a list of all the filenames, with the page number and the ID no. used in Section 6.

JCL file [1]	.OPJCL.CNTL(GDI1PEN)	83
JCL file [2]	.OPJCL.CNTL(GDI1CDEN)	84
JCL file [3]	.TSS.CLIST	85
JCL file [4]	.TSSMAC.CLIST(RZOUT3)	85
JCL file [5]	.OPJCL.CNTL(GDG0SJC)	85
JCL file [6]	.OPJCL.CNTL(GDI1MASS)	87
JCL file [7]	.OPJCL.CNTL(GDI1SC)	88
JCL file [8]	.OPJCL.CNTL(GDI3PSLA)	89
JCL file [9]	.OPJCL.CNTL(GDI3P70N)	90
JCL file [10]	.OPJCL.CNTL(GDI3P70V)	91
JCL file [11]	.OPJCL.CNTL(GDI3P18N)	92
JCL file [12]	.OPJCL.CNTL(GDI3P70D)	93
JCL file [13]	.OPJCL.CNTL(GDI3PNL)	94
JCL file [14]	.OPJCL.CNTL(GDI3PDNF)	95
JCL file [15]	.OPJCL.CNTL(GDI3PEV)	96
JCL file [16]	.OPJCL.CNTL(GDI3PFD0)	97
JCL file [17]	.OPJCL.CNTL(GDI3PFD1)	98
JCL file [18]	.OPEDID.DATA(DUMPGDI1)	98
JCL file [19]	.OPJCL.CNTL(GDI1MY)	102
JCL file [20]	.OPJCL.CNTL(GDI1XSLA)	103
JCL file [21]	.OPJCL.CNTL(GDI1X70N)	104
JCL file [22]	.OPJCL.CNTL(GDI1X70D)	106
JCL file [23]	.OPJCL.CNTL(GDI1PERK)	107
JCL file [24]	.OPJCL.CNTL(GDI1MBRN)	110

Data file [1]	.OPDEND.DATA(GDI1P)	112
Data file [2]	.OPCITD.DATA(0975M165)	112
Data file [3]	.OPEDID.DATA(GDI1RZ)	116
Data file [4]	.OPFORT.DATA(GDI1RZ)	116
Data file [5]	.OPDEND.DATA(GDG0S)	118
Data file [6]	.OPCITD.DATA(PHA1N70)	120
Data file [7]	.OPEDID.DATA(PFC1F)	120

Data file [8]	.OPEDID.DATA(PFC1C)	121
Data file [9]	.OPEDID.DATA(PFC1M)	121
Data file [10]	.OPDEND.DATA(GDI1S)	122
Data file [11]	.OPCITD.DATA(PEE1D70O)	124
Data file [12]	.OPDEND.DATA(GDI3PRT)	126
Data file [13]	.OPCITD.DATA(PIJ3P70N)	129
Data file [14]	.OPEDID.DATA(PIJ3PF)	130
Data file [15]	.OPEDID.DATA(PIJ3PC)	130
Data file [16]	.OPCITD.DATA(PIJ3PV70)	131
Data file [17]	.OPCITD.DATA(PIJ3PADJ)	132
Data file [18]	.OPCITD.DATA(PIJ3P70D)	133
Data file [19]	.OPEDID.DATA(PIJ3PNL)	133
Data file [20]	.OPEDID.DATA(PIJ3PDNX)	134
Data file [21]	.OPEDID.DATA(PIJ3PEV)	135
Data file [22]	.OPEDID.DATA(PIJ3PFD0)	136
Data file [23]	.OPEDID.DATA(GDI3PFD1)	136
Data file [24]	.OPMOSD.DATA(GDI1DY)	140
Data file [25]	.OPDEND.DATA(GDI1RZEC)	143
Data file [26]	.OPCITD.DATA(PFC3N70X)	145
Data file [27]	.OPEDID.DATA(PFC3FX)	145
Data file [28]	.OPEDID.DATA(PFC3C18X)	146
Data file [29]	.OPEDID.DATA(PFC3MX)	146
Data file [30]	.OPEDID.DATA(NAMEF#XX)	147
Data file [31]	.OPEDID.DATA(IDNUMXX)	147
Data file [32]	.OPEDID.DATA(CHIMG)	149
Data file [33]	.OPEDID.DATA(ZONE#XX)	149
Data file [34]	.OPMOSD.DATA(GDI1MBRN)	149

If the above files are no longer present in the permanent filespace under uid POC0B17, they can be retrieved from archive on my magnetic cartridge, identifier SNHBU3.

The JCL file to run the retrieval is .ARCHTAPE.CNTL(REST30) , a listing is included after the last data file. It may be necessary to alter the names of the files that are retrieved (e.g. to temporary filespace), do this by altering the SYSUT2 data in each step of the JCL.

Example JCL Files

JCL file [1] .OPJCL.CNTL(GDI1PEN)

PENCIL, 'iterative condensation' & 'basic fuel cycle'

```
//POC0B17D JOB (),PNCL850R,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),     00010022
// CLASS=C,TIME=0030                                                     00020020
//*--------------------------------------------------------------------- 00030007
//IMAGELIB DD DSN=POC3A12.IMAGELIB,DISP=SHR                             00040007
//DATAP1 EXEC PGM=DATAP1                                                00090007
//*PSYS    DD SUBSYS=(VPCS)                                             00100017
//STEPLIB  DD DSN=POC3AA3.LIB.LOAD,DISP=SHR,LABEL=(,,,IN)               00110000
//*              ++++++++++++++++++++++++++++        INPUT GEOMETRY DATA00120010
//FT05F001 DD DSN=POC0B17.OPDEND.DATA(GDI1P),DISP=SHR,LABEL=(,,,IN)     00121021
//*              --------------------------                             00122010
//FT06F001 DD SYSOUT=*                                                  00130000
//*--------------------------------------------------------------------- 00140000
//*     PENCIL                                                          00150000
//*--------------------------------------------------------------------- 00160000
//PENCIL EXEC PGM=PENCIL,COND=(4,LT)                                    00170007
//*PSYS    DD SUBSYS=(VPCS)                                             00180017
//STEPLIB  DD DSN=POC3A12.PENCIL52.LOAD,DISP=SHR,LABEL=(,,,IN)          00190043
//*             CORRECTED PENCIL VERSION - VB4C & NZRH COMPATIBLE       00200043
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(20,2)),                            00210000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                   00220000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00230000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00240000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00250000
//FT05F001 DD DSN=&&CIT,DISP=(NEW,PASS),UNIT=WORK,                      00260007
//            SPACE=(TRK,(10,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=26720)  00270007
//FT06F001 DD SYSOUT=*,DCB=(RECFM=UA,BLKSIZE=137)                       00290000
//FT07F001 DD UNIT=SYSDA,SPACE=(TRK,(50,50)),DCB=*.FT01F001             00300000
//*              ++++++++++++++++++++          7 GROUP MICRO DATA00310010
//FT08F001 DD DSN=POC0B17.OBHZHBC3.MIC18G3,DISP=SHR,LABEL=(,,,IN)       00311017
//*              ----------------------                                 00312010
//*---( OUTPUT  FLUX MAP )-----------------------------------------**    00320000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               00330000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00340000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00350000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00360000
//*---( RESTART FILE )--------------------------------------------**    00370000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00380000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00390000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001              00400000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00410000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00420000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00430000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               00440000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00450000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00460000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00470000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00480000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00490000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00500000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00510000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00520000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00530000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00540000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00550000
//*---( MACRO CROSS SECTIONS )------------------------------------------ 00560000
//FT31F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00570000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00580000
//FT33F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               00590000
//*---( OUTPUT RESULT FILE )--------------------------------------       00600000
//FT34F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               00610000
//FT35F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               00620000
//FT36F001 DD DUMMY                                                     00630000
//FT37F001 DD DUMMY                                                     00640000
//*---( OUTPUT LIST )---------------------------------------------       00650000
//FT51F001 DD DUMMY                                                     00660000
//FT52F001 DD DUMMY                                                     00670000
//FT80F001 DD DUMMY                                                     00680000
//FT81F001 DD DUMMY                                                     00690000
//*---( OUTPUT FLUX FILE )----------------------------------------       00700000
//FT91F001 DD DSN=&&FLUX,DISP=(NEW,PASS),SPACE=(TRK,(20,10),RLSE),      00710007
//            UNIT=WORK,DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)         00720007
//*---( OUTPUT POWER FILE )---------------------------------------       00730000
//FT92F001 DD DSN=&&POWER,DISP=(NEW,PASS),SPACE=(TRK,(1,1),RLSE),       00740007
//            UNIT=WORK,DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)         00750007
//*              ++++++++++++++++++++++++++          INPUT GEOMETRY DATA00770011
//FT93F001 DD DSN=POC0B17.OPDEND.DATA(GDI1P),DISP=SHR,LABEL=(,,,IN)     00771021
//*              --------------------------                             00772010
//*              ++++++++++++++++++++++++++          INPUT CITATION FILE00790010
//FT94F001 DD DSN=POC0B17.OPCITD.DATA(0975M165),DISP=SHR,LABEL=(,,,IN)  00791010
//*              --------------------------                             00792010
//*              ++++++++++++++++++++++++++       OUTPUT TABLE DATA LIST00810010
//FT95F001 DD DSN=POC0B17.PQINT.DATA(TABLE),DISP=SHR                    00811015
//*              --------------------------                             00812010
//*              ++++++++++++++++++++++++++       OUTPUT APPLE DATA FILE00830010
//FT96F001 DD DSN=POC0B17.PQINT.DATA(APPLE),DISP=SHR                    00831015
//*              --------------------------                             00832010
//*--------------------------------------------------------------------- 00840000
//*     PENEDIT                                                         00850000
//*--------------------------------------------------------------------- 00860000
//CITCPY EXEC PGM=PENEDIT                                               00870007
//*PSYS    DD SUBSYS=(VPCS)                                             00880017
//STEPLIB  DD DSN=POC3A12.PENEDIT.LOAD,DISP=SHR,LABEL=(,,,IN)           00890000
//FT02F001 DD DSN=&&CIT,DISP=(OLD,DELETE),UNIT=SYSDA                    00900000
//*              ++++++++++++++++++++++          OUTPUT CITATION DATA00910010
//FT12F001 DD DSN=POC0B17.PQINT.DATA(CIT),DISP=SHR                      00911015
//*              ----------------------                                 00912010
//FT06F001 DD SYSOUT=*                                                  00920000
//*--------------------------------------------------------------------- 00930000
```

```
//*     APPLE4                                                                  00940000
//*------------------------------------------------------------------------- 00950000
//APPLE4 EXEC PGM=APPLE4                                                      00960007
//*PSYS    DD SUBSYS=(VPCS)                                                   00970017
//STEPLIB  DD DSN=POC3AA3.APPLEW.LOAD,DISP=SHR,LABEL=(,,,IN)                 00980000
//FT01F001 DD DSN=&&AW1,DISP=(NEW,PASS),UNIT=SYSDA,                          00990000
//            SPACE=(TRK,(10,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)        01000000
//FT02F001 DD DSN=&&AW2,DISP=(NEW,PASS),UNIT=SYSDA,                          01010000
//            SPACE=(TRK,(10,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)        01020000
//FT03F001 DD SYSOUT=*,DCB=(RECFM=UA,BLKSIZE=133)                            01030000
//*               ++++++++++++++++++++++++++++          OUTPUT APPLE FILE01040010
//FT05F001 DD DSN=POC0B17.PQINT.DATA(APPLE),DISP=SHR,LABEL=(,,,IN)           01041015
//*               ----------------------------                               01042010
//FT06F001 DD SYSOUT=*                                                       01050000
//FT07F001 DD DUMMY                                                          01060000
//PLOTLOG  DD SYSOUT=*                                                       01070000
//PLOTPRM  DD *                                                              01080000
SCALE=0.697                                                                  01090000
/*                                                                           01100000
//GDFILE   DD SYSOUT=*                                                       01110000
//*------------------------------------------------------------------------- 01120000
//*     TABLE1                                                               01130000
//*------------------------------------------------------------------------- 01140000
//TABLE  EXEC PGM=TABLE1                                                     01150000
//*PSYS    DD SUBSYS=(VPCS)                                                  01160017
//STEPLIB  DD DSN=POC3A12.LIB.LOAD,DISP=SHR                                  01170000
//*               ++++++++++++++++++++++++          OUTPUT CITATION DATA01180010
//FT01F001 DD DSN=POC0B17.PQINT.DATA(CIT),DISP=SHR                           01181015
//*               ------------------------                                   01182010
//FT02F001 DD DUMMY                                                          01190000
//FT03F001 DD DUMMY                                                          01200000
//*               ++++++++++++++++++++++++++          OUTPUT APPLE FILE01210010
//FT04F001 DD DSN=POC0B17.PQINT.DATA(APPLE),DISP=SHR,LABEL=(,,,IN)           01211015
//*               -------------------------                                  01212010
//*               ++++++++++++++++++++++++++          OUTPUT TABLE LIST01213010
//FT05F001 DD DSN=POC0B17.PQINT.DATA(TABLE),DISP=SHR,LABEL=(,,,IN)           01220015
//*               -------------------------                                  01221010
//*               ++++++++++++++++++++++        INPUT 7 GROUP MICRO DATA01222010
//FT07F001 DD DSN=POC0B17.OBHZHBC3.MIC18G3,DISP=SHR,LABEL=(,,,IN)            01230017
//*               ----------------------                                     01231010
//*               ++++++++++++++++++++++++++        INPUT GEOMETRY DATA01232011
//FT08F001 DD DSN=POC0B17.OPDEND.DATA(GDI1P),DISP=SHR,LABEL=(,,,IN)          01240021
//*               --------------------------                                 01241010
//FT06F001 DD SYSOUT=*,FLASH=TBL1                                            01250000
//*------------------------------------------------------------------------- 01260000
//*     RZPLOT                                                               01270000
//*------------------------------------------------------------------------- 01280000
//RZPLOT EXEC PGM=RZPLOT,COND=(4,LT)                                         01290007
//*PSYS    DD SUBSYS=(VPCS)                                                  01300017
//STEPLIB  DD DSN=POC3AA3.LIB.LOAD,DISP=SHR                                  01310000
//*               ++++++++++++++++++++++          OUTPUT CITATION DATA01320010
//FT05F001 DD DSN=POC0B17.PQINT.DATA(CIT),DISP=SHR,LABEL=(,,,IN)             01321015
//*               ------------------------                                   01322010
//FT06F001 DD SYSOUT=*                                                       01330000
//GDFILE   DD SYSOUT=*                                                       01340000
//PLOTPRM  DD DUMMY                                                          01350000
//PLOTLOG  DD DUMMY                                                          01360000
//                                                                           01370000
```


JCL file [2] .OPJCL.CNTL(GDI1CDEN)

CITDENS, 'iterative condensation' & 'basic fuel cycle'

```
//POC0B17C JOB (),CITDENS,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),          00010081
// CLASS=C,TIME=0015                                                         00020081
//*************************************************************************** 00030006
//CITATION EXEC PGM=CITATION,COND=(4,LT)                                     00040000
//*PSYS    DD SUBSYS=(VPCS)                                                  00050027
//STEPLIB  DD DSN=POC3A12.CITDENS.LOAD,DISP=SHR,LABEL=(,,,IN)                00060000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(20,2)),                                 00070000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                        00080000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00090000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00100000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00110000
//*               ++++++++++++++++++++++++          INPUT CITATION DATA00120010
//FT05F001 DD DSN=POC0B17.PQINT.DATA(CIT),DISP=SHR,LABEL=(,,,IN)             00130057
//*               ------------------------                                   00140010
//FT06F001 DD SYSOUT=*                                                       00150000
//FT07F001 DD UNIT=SYSDA,SPACE=(TRK,(50,50)),DCB=*.FT01F001                  00160000
//*               ++++++++++++++++++++++          INPUT 7 GROUP MICRO DATA00170010
//FT08F001 DD DSN=POC0B17.OBHZHBC3.MIC18G3,DISP=SHR,LABEL=(,,,IN)            00180088
//*               ----------------------                                     00190010
//*---( OUTPUT  FLUX MAP )-----------------------------------------**        00260000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                    00270000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00280000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001                   00290000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001                   00300000
//*---( RESTART FILE )--------------------------------------------**        00310000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001                   00320000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001                   00330000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001                   00340000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001                   00350000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001                   00360000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001                   00370000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                    00380000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00390000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00400000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001                  00410000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00420000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00430000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00440000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001                  00450000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00460000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001                  00470000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00480000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                    00490000
//*---( MACRO CROSS SECTIONS )-------------------------------------------00500000
//FT31F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001                  00510000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001                  00520000
//FT33F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                    00530000
//*---( OUTPUT RESULT FILE )---------------------------------------        00540000
//FT34F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                    00550000
//FT36F001 DD DUMMY                                                          00560000
//FT37F001 DD DUMMY                                                          00570000
```

```
//FT51F001 DD DUMMY                                                      00580000
//*              ++++++++++++++++++          OUTPUT MULTIPLE N.D. FILE00590011
//FT52F001 DD DSN=POC0B17.@GDI1.DENS,DISP=(NEW,CATLG),                   00591090
//*              ------------------                                      00592011
//            SPACE=(TRK,(90,10),RLSE),UNIT=DASD,                        00600065
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425)                     00610000
//*---( BURNUP FACTOR FILE )-----------------------------------          00620000
//FT63F001 DD DUMMY                                                      00630000
//FT80F001 DD DUMMY                                                      00640000
//FT81F001 DD DUMMY                                                      00650000
//FT92F001 DD DSN=&&POFU,DISP=(NEW,PASS),SPACE=(TRK,(100,10),RLSE),      00660000
//            UNIT=WORK,DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)          00670000
//                                                                       00680000
```

JCL file [3] .TSS.CLIST

RZOUT3 enabling MACRO

```
00000001/* CLIST CONVERSION COMPLETED    91/11/13  */
00000100PROC 0  OFF
00000201WRITE  *** TSS COMMAND SYSTEM  u2    F u u u   ***
00000210CONTROL NOMSG
00000300FREE F(SYSPROC)
00000400/* PROFILE PAUSE
00000500ALLOC DA('POC0B17.TSSMAC.CLIST' +
00000501         'POC0AA1.TSSMAC.CLIST' +
00000502         'POC3AA3.CMDPROC.CLIST' +
00000503         'POC3C##.CMDPROC.CLIST' +
00000610         'SYS9.CMDPROC.CLIST') +
00000700      F(SYSPROC) SHR
00000710    IF &LASTCC ^=0 THEN +
00000720      DO
00000730      WRITE *** TSS COMMAND  u  H JuGu u u u3  ***
00000731      SE '***PLEASE FREE YOUR DATASET *** FROM' U(POC3CA1) L
00000740      END
00000800CONTROL MSG
00000801/*EX 'POC3AA3.CMDPROC.CLIST(TSSOFF)' 'ON'
00000900EXIT
```

JCL file [4] .TSSMAC.CLIST(RZOUT3)

RZOUT3 command MACRO

```
00010045   PROC 1 MEM  STM(&SYSTIME) BNK('          ')
00020053   CONTROL NOLIST   MSG NOF
00030000   SET &DCB1=&STR(@1&SUBSTR(1:2,&STM)&SUBSTR(4:5,&STM)&SUBSTR(7:8,&STM))
00040000   SET &DCB2=&STR(@2&SUBSTR(1:2,&STM)&SUBSTR(4:5,&STM)&SUBSTR(7:8,&STM))
00050000   SET &DCB3=&STR(@3&SUBSTR(1:2,&STM)&SUBSTR(4:5,&STM)&SUBSTR(7:8,&STM))
00060000   SET &WORK=&STR(@W&SUBSTR(1:2,&STM)&SUBSTR(4:5,&STM)&SUBSTR(7:8,&STM))
00070000   ATTR &DCB1 REC(F B)   LR( 80) BLK(3120)
00080000   ATTR &DCB2 REC(F B A) LR(133) BLK(3990)
00090000   ATTR &DCB3 INPUT
00100000   SET  &SPC = &STR(&BNK&BNK&BNK&BNK&BNK&BNK&BNK&BNK)
00110048   SET  &DNS = &STR(POC0B17.@&MEM..DENS)
00120000   SET  &LEN = &LENGTH(&DNS)
00121044   SET  &MEMA = &STR(&MEM.RZ)
00140000   WRITE DNS = &DNS
00141046   WRITE MEMA = &MEMA
00150053   CONTROL NOLIST NOMSG NOF
00160098   EDIT 'POC0B17.OPEDID.DATA(&MEMA)' DATA
00170016   TOP;F 'ISTEP';L *
00180016   END NOSAVE
00190067   CONTROL   LIST   MSG NOF
00210067     ALLOC F(FT60F001) DA(&WORK) SP(10) T UNI(DASD) REU US(&DCB1)
00220000           OPENFILE  FT60F001 OUTPUT
00230000                SET &FT60F001 = &STR(&DNS&SUBSTR(&LEN+1:80,&SPC))
00240000            PUTFILE  FT60F001
00250000           CLOSFILE  FT60F001
00260039     ALLOC F(FT01F001) DA('&DNS') SHR REU US(&DCB3)
00270098  ALLOC F(FT05F001) DA('POC0B17.OPEDID.DATA(&MEM.RZ)') SHR REU US(&DCB3)
00280006     ALLOC F(FT06F001) DA(@@.LIST) NE CA SP(1 1) T REU US(&DCB2)
00290000     ALLOC F(FT60F001) DA(&WORK) MOD REU
00320002   FORT 'POC0AA1.UTY.FORT77(RZOUT3NN)'
00330000   FREE  F(FT01F001,FT60F001)
00340000   ALC 5 * ; ALC 6 *
00360019   WRITENR ENTER MEMBER NAME : &MEM
00370019    READ &MEMB
00380019      IF &MEMB = &STR() THEN SET &MEMB = &MEM
00381044   SET &MEMB = &STR(&MEMB.RZ)
00390099   COPY  &WORK OPFORT.DATA(&MEMB)
00400000   DEL   &WORK
00410012   DEL   @@.LIST
00420000   EXIT
```

JCL file [5] .OPJCL.CNTL(GDG0SJC)

SLAROM-JOINT-CITATION, 'iterative condensation'

```
//POC0B17Z JOB (),'NEMC7GOR',MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),  00010040
// CLASS=C,TIME=0010                                                    00020033
//******************************                                       00030000
//***        SLAROM          ***                                       00040000
//******************************                                       00050000
//DATAP1  EXEC PGM=DATAP1                                              00060019
//STEPLIB  DD DSN=POC3AA3.LIB.LOAD,DISP=SHR,LABEL=(,,,IN)              00070000
//FT06F001 DD SYSOUT=*                                                 00080020
//*              ++++++++++++++++++++++++++          INPUT SLAROM N.D.00110002
//FT05F001 DD DSN=POC0B17.OPDEND.DATA(GDG0S),DISP=SHR,                 00120050
//*              -------------------------                             00121002
//            LABEL=(,,,IN)                                            00130000
//*************************************************************************00140000
//SLAGO  EXEC PGM=SLAROM                                               00160000
//STEPLIB  DD DSN=POC0EA1.SLAROM.NEDAC.LOAD,DISP=SHR                   00180001
//*------( INPUT PDS  )-------------------------------------------------00190000
```

```
//PDSIN    DD DUMMY                                                    00200000
//*------( OUTPUT PDS )-------------------------------------------------00210000
//PDSOUT   DD DSN=&&XSG70,UNIT=WORK,                                   00220000
//            DISP=(NEW,PASS),                                        00230000
//            DCB=(RECFM=U,BLKSIZE=26793),                            00240000
//            SPACE=(CYL,(20,10,40),RLSE)                             00250000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),                          00270000
//            DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)                 00280000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00290000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001            00300000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00310000
//*              ++++++++++++++++++++++++++          INPUT SLAROM N.D.00320002
//FT05F001 DD DSN=POC0B17.OPDEND.DATA(GDG0S),DISP=SHR,                00330050
//*              ---------------------------                          00331002
//            LABEL=(,,,IN)                                           00340000
//FT06F001 DD DSN=&&LIST2,DISP=(NEW,PASS),                            00351031
//            SPACE=(CYL,(10,3)),                                     00360031
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK        00370031
//FT07F001 DD DUMMY                                                   00380000
//*              +++++++++++++++++++++          INPUT REF. 70 GROUP MICRO00390002
//FT08F001 DD DSN=POC0H##.JFS3J3.Y9406,DISP=SHR,LABEL=(,,,IN)         00420010
//*              ----------------------                               00430002
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00440000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001            00450000
//FT11F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00460000
//FT12F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00470000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001            00480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00500000
//FT22F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00510000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00520000
//FT26F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00530000
//FT30F001 DD DUMMY                                                   00540000
//FT40F001 DD SYSOUT=*                                                00550000
//FT41F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00560000
//FT42F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00570000
//FT43F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00580000
//FT55F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00590000
//FT56F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00600000
//FT59F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00610000
//FT60F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00620000
//FT70F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00630000
//FT72F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00640000
//FT73F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00650000
//FT71F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00660000
//FT80F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00670000
//FT90F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00680000
//FT96F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00690000
//FT99F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001             00700000
//*************************************************************       00710000
//LOUT2  EXEC COMPACT,PARM='TYPE2,CC=NO'                              00720031
//UTYIN    DD DSN=&&LIST2,DISP=(OLD,DELETE)                           00730031
//*****************************************************************//00770000
//*     JOINT ---> CITATION                                         *//00790000
//*****************************************************************//00810000
//DATAP2   EXEC PGM=DATAP1                                            00820019
//STEPLIB  DD DSN=POC3AA3.LIB.LOAD,DISP=SHR,LABEL=(,,,IN)             00830000
//*              ++++++++++++++++++++++++++++    INPUT CIT. DATA 70 GP.00840002
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PHA1N70),                       00841034
//*              ----------------------------                         00842002
//            DISP=SHR,LABEL=(,,,IN)                                  00850000
//FT06F001 DD SYSOUT=*                                                00860020
//*                                                                   00890000
//*                                                                   00920000
//JOINT1   EXEC PGM=JOINTX                                            00950001
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR                         00960001
//SYSPRINT DD SYSOUT=*                                                00970000
//USERPDS  DD DSN=&&XSG70,DISP=(OLD,PASS)                             00980000
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,10)),                         00990000
//            DISP=(,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1) 01000000
//*              ++++++++++++++++++++++++++++    INPUT CIT. DATA 70 GP.01010002
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PHA1N70),DISP=SHR,              01011034
//*              ----------------------------                         01012002
//            LABEL=(,,,IN)                                           01020000
//FT06F001 DD SYSOUT=*                                                01030020
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                      01060000
//            SPACE=(TRK,(10,10)),                                    01070000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                    01080000
//FT09F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                      01090000
//            SPACE=(TRK,(10,10))                                     01100000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                      01110000
//            SPACE=(TRK,(10,10)),                                    01120000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                    01130000
//FT20F001 DD DUMMY                                                   01140000
//FT50F001 DD SYSOUT=*                                                01150000
//*                                                                   01160000
//*-----------------(  CITATION  )-----------------------------------01190000
//CITATION EXEC PGM=CITATION,COND=(4,LT)                              01200000
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR                        01210000
//SYSPRINT DD SYSOUT=*                                                01220000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                           01230000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                 01240000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001             01250000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001             01260000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001             01270000
//FT05F001 DD DSN=*.JOINT1.FT08F001,DISP=(OLD,DELETE)                 01280000
//FT06F001 DD SYSOUT=*                                                01290000
//*---( OUTPUT  ZONE AVERAGED FLUX & AXIAL BUCKLING )------------***   01300000
//FT07F001 DD DSN=&&CIT,DISP=(NEW,PASS),UNIT=WORK,                    01310000
//            SPACE=(TRK,(2,1),RLSE),                                 01320000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)                    01330000
//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                           01340000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                 01350000
//*---( OUTPUT  FLUX MAP )-----------------------------------------**  01360000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001             01370000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001             01380000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001            01390000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001            01400000
//*---( RESTART FILE )-------------------------------------------**    01410000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001            01420000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001            01430000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(2,5)),DCB=*.FT01F001             01440000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001            01450000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001            01460000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001            01470000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001             01480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001             01490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001             01500000
```

```
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001                01510000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                 01520000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                 01530000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                 01540000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001               01550000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                 01560000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001               01570000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                 01580000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                 01590000
//*---( MACRO CROSS SECTIONS )-------------------------------------------01600000
//FT31F001 DD DSN=*.JOINT1.FT09F001,DISP=(OLD,DELETE)                     01610000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001               01620000
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001               01630000
//*---( OUTPUT RESULT FILE )---------------------------------------       01640000
//FT34F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                 01650000
//FT51F001 DD SYSOUT=*                                                    01660020
//*                                                                       01690000
//*-----------------(  JOINT.MIC  )-------------------------------------01720000
//JOINT2   EXEC PGM=JOINTX                                                01750001
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)               01760001
//SYSPRINT DD SYSOUT=*                                                    01770000
//*              ++++++++++++++++++++          OUTPUT 70 GROUP FLUX01780002
//USERPDS  DD DSN=POC0B17.@GDG170.FLUX,DISP=(NEW,CATLG),UNIT=DASD,        01781043
//*              --------------------                                     01782002
//        DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),                            01790000
//        SPACE=(TRK,(5,1,3),RLSE)                                        01800000
//FT01F001 DD DSN=&&CIT,DISP=(OLD,DELETE)                                 01810000
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                               01820000
//*              ++++++++++++++++++++++++++     INPUT FLUX EDIT CONTROL01830002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PFC1F),DISP=SHR                     01831027
//*              --------------------------                               01832002
//FT06F001 DD SYSOUT=*                                                    01840000
//FT90S001 DD SYSOUT=*                                                    01850000
//*--------------------(  JOINT.MIC  )-------------------------------------01870000
//JOINT3   EXEC PGM=JOINTX                                                01900001
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)               01910001
//SYSPRINT DD SYSOUT=*                                                    01920000
//PDSIN    DD DSN=&&XSG70,DISP=(OLD,DELETE)                               01930000
//*              ++++++++++++++++++++++          OUTPUT 7 GP. MICRO (PDS)01940003
//PDSOUT   DD DSN=POC0B17.@GDG118.PDSMIC,                                 01960043
//*              ---------------------                                    01961002
//      UNIT=DASD,DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),DISP=(NEW,CATLG),   01970000
//      SPACE=(TRK,(20,1,30))                                             01980000
//*              ++++++++++++++++++++          OUTPUT 70 GROUP FLUX01990002
//USERPDS  DD DSN=POC0B17.@GDG170.FLUX,DISP=SHR                           02000043
//*              ---------------------                                    02001002
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                               02010000
//*              ++++++++++++++++++++++++++  INPUT CONDENSATION CONTROL02020002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PFC1C),DISP=SHR,                    02021048
//*              --------------------------                               02022002
//           LABEL=(,,,IN)                                                02030000
//FT06F001 DD SYSOUT=*                                                    02040000
//FT90S001 DD SYSOUT=*                                                    02050000
//*-----------------(  JOINT  )-------------------------------------------02070000
//MICRO    EXEC PGM=JOINTX                                                02100001
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)               02110001
//SYSPRINT DD SYSOUT=*,                                                   02120000
//        DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)                         02130000
//*              ++++++++++++++++++++          OUTPUT 7 GP. MICRO (PDS)02140002
```



```
//USERPDS  DD DSN=POC0B17.@GDG118.PDSMIC,DISP=SHR                         02141043
//*              ---------------------                                    02142002
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2)),                              02150000
//        DISP=(,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1)       02160000
//*              ++++++++++++++++++++++++++     INPUT MICRO EDIT CONTROL02170002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PFC1M),DISP=SHR                     02171027
//*              --------------------------                               02172002
//FT06F001 DD SYSOUT=*                                                    02180020
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                          02230000
//        SPACE=(TRK,(10,10)),                                            02240000
//        DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                            02250000
//*              ++++++++++++++++++          OUTPUT 7 GP. MICRO (SLAROM)02270002
//FT09F001 DD DSN=POC0B17.OBHZHBC7.MIC7GJ3,DISP=(NEW,CATLG),UNIT=SYSDA,  02280050
//*              ------------------                                       02281002
//        SPACE=(TRK,(10,5),RLSE),                                        02290000
//        DCB=(RECFM=VBS,LRECL=X,BLKSIZE=26793)                           02300000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                          02320000
//        SPACE=(TRK,(10,10)),                                            02330000
//        DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                            02340000
//FT20F001 DD DUMMY                                                       02350000
//FT50F001 DD SYSOUT=*,                                                   02360000
//        DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)                         02370000
//*                                                                       02380000
//                                                                        02410000
```

JCL file [6] .OPJCL.CNTL(GDI1MASS)

MASSN mass balance, 'basic fuel cycle'

```
//POC0B17M JOB (),MASSN,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(1,1),
//        CLASS=A,TIME=0001
//*-------------------------------------------------------------------------
//IMAGELIB DD  DSN=POC3AA3.IMAGELIB.DATA,DISP=SHR,LABEL=(,,,IN)
//FORTEX EXEC PGM=JWD@FORT,PARM='NOS,LC(60),OPT(2),LANGLVL(77),NUM'
//SYSPRINT DD SYSOUT=*
//SYSLIN   DD DSN=&&OBJ,DISP=(NEW,PASS),UNIT=SYSDA,
//           SPACE=(TRK,(15,15)),DCB=BLKSIZE=3200
//SYSIN    DD DSN=POC0AA1.UTY.FORT77(MASSNSPC),DISP=SHR
//LKED77 EXEC PGM=JQAL,PARM='NOLIST,NOMAP,LET'
//SYSPRINT DD DUMMY
//SYSLIB   DD DSN=SYS2.FORTLIB,DISP=SHR
//SYSUT1   DD UNIT=SYSDA,SPACE=(TRK,(30,10))
//SYSLMOD  DD DSN=&&LOAD,DISP=(NEW,PASS),UNIT=SYSDA,
//           SPACE=(TRK,(100,20,5)),DCB=(RECFM=U,BLKSIZE=13030)
//SYSLIN   DD DSN=&&OBJ,DISP=(OLD,DELETE)
//*-------------------------------------------------------------------------
//RUN     EXEC PGM=TEMPNAME
//STEPLIB  DD DSN=&&LOAD,DISP=SHR
//FT05F001 DD *
 297 4  7.422  0.0
 52 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85 85
 85 85 85 85 85 85 85 85  6  6  6  6  6  6  6  6  6  6  6  6  6
  9  9  9  9  9
  8  1  2  3  4  5  6  7  8
```

```
 24  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
 32
  0  0
  0  0
 235 288   0   6   0  29   0
 600MW/60CM HQ PU 40.25/45.03%,165%FUEL,4*9.75M.,24/8P ZRH/B4C OPT.
/*
//FT20F001 DD DUMMY RES CAN
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)
//FT07F001 DD SYSOUT=*,FLASH=PLK1,DCB=(RECFM=UA,BLKSIZE=900,OPTCD=U)
//FT09F001 DD SYSOUT=*,FLASH=PLK2,DCB=(RECFM=UA,BLKSIZE=900,OPTCD=U)
//FT10F001 DD SYSOUT=*,FLASH=PLK3,DCB=(RECFM=UA,BLKSIZE=900,OPTCD=U)
//FT11F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)
//*               ++++++++++++++++++          INPUT MULTIPLE N.D.FILE
//FT08F001 DD DSN=POC0B17.GDI1.DENS,DISP=SHR,LABEL=(,,,IN)
//*               ------------------
//FT98F001 DD DSN=POC0AA1.ORGBASE.DATA,DISP=SHR,LABEL=(,,,IN)
//FT99F001 DD DUMMY
//
```

JCL file [7] .OPJCL.CNTL(GDI1SC)

SLAROM-CITATION, 'basic fuel cycle'

```
//POC0B17D JOB (),'NEMC7GOR',MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),  00010005
// CLASS=C,TIME=0015                                                    00020010
//******************************                                       00030000
//***        SLAROM          *** SOC   RODS 0%    HET. RODS            00040016
//******************************                                       00050000
//DATAP1  EXEC PGM=DATAP1                                              00060000
//STEPLIB  DD DSN=POC3AA3.LIB.LOAD,DISP=SHR,LABEL=(,,,IN)              00070000
//FT06F001 DD SYSOUT=*                                                 00080000
//*               ++++++++++++++++++++++++++          INPUT SLAROM N.D.00110000
//FT05F001 DD DSN=POC0B17.OPDEND.DATA(GDI1S),DISP=SHR,                 00120018
//*               --------------------------                           00121000
//            LABEL=(,,,IN)                                            00130000
//*************************************************************************00140000
//SLAGO  EXEC PGM=SLAROM                                               00160000
//STEPLIB  DD DSN=POC0EA1.SLAROM.NEDAC.LOAD,DISP=SHR                   00180000
//*------( INPUT PDS  )-------------------------------------------------00190000
//PDSIN    DD DUMMY                                                    00200000
//*------( OUTPUT PDS )-------------------------------------------------00210000
//PDSOUT   DD DSN=&&XSG70,UNIT=WORK,                                   00220000
//            DISP=(NEW,PASS),                                         00230000
//            DCB=(RECFM=U,BLKSIZE=26793),                             00240000
//            SPACE=(CYL,(20,10,40),RLSE)                              00250000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),                           00270000
//            DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)                  00280000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00290000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001             00300000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00310000
//*               ++++++++++++++++++++++++++          INPUT SLAROM N.D.00320000
//FT05F001 DD DSN=POC0B17.OPDEND.DATA(GDI1S),DISP=SHR,                 00330018
//*               --------------------------                           00331000
```



```
//            LABEL=(,,,IN)                                            00340000
//FT06F001 DD DSN=&&LIST2,DISP=(NEW,PASS),                             00351007
//            SPACE=(CYL,(10,3)),                                      00360007
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK         00370007
//FT07F001 DD DUMMY                                                    00380000
//*               ++++++++++++++++++++          INPUT REF. 70 GROUP MICRO00390000
//FT08F001 DD DSN=POC0H##.JFS3J3.Y9406,DISP=SHR,LABEL=(,,,IN)          00420000
//*               --------------------                                 00430000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00440000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001             00450000
//FT11F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00460000
//FT12F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00470000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001             00480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00500000
//FT22F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00510000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00520000
//FT26F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00530000
//FT30F001 DD DUMMY                                                    00540000
//FT40F001 DD SYSOUT=*                                                 00550000
//FT41F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00560000
//FT42F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00570000
//FT43F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00580000
//FT55F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00590000
//FT56F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00600000
//FT59F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00610000
//FT60F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00620000
//FT70F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00630000
//FT72F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00640000
//FT73F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00650000
//FT71F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00660000
//FT80F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00670000
//FT90F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00680000
//FT96F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00690000
//FT99F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00700000
//*************************************************************        00710000
//********** SUPPRESS OUTPUT ***************************************  00711009
//*LOUT2  EXEC COMPACT,PARM='TYPE2,CC=NO'                              00720009
//*UTYIN    DD DSN=&&LIST2,DISP=(OLD,DELETE)                           00730009
//*********************************************************************//00770000
//*     JOINT ---> CITATION                                           *//00790000
//*********************************************************************//00810000
//DATAP2   EXEC PGM=DATAP1                                             00820000
//STEPLIB  DD DSN=POC3AA3.LIB.LOAD,DISP=SHR,LABEL=(,,,IN)              00830000
//*               ++++++++++++++++++++++++++++    INPUT CIT. DATA 70 GP.00840000
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PEE1D70O),                       00841000
//*               ----------------------------                         00842000
//            DISP=SHR,LABEL=(,,,IN)                                   00850000
//FT06F001 DD SYSOUT=*                                                 00860000
//*                                                                    00890000
//*     JOINT UPDATE PROCESS                                          *//00900001
//*                                                                    00920000
//FORT EXEC FORTECL,PARM.FORT='NOSOURCE,LC(99)'                        00930001
//FORT.SYSIN DD *                                                      00940001
      DIMENSION A(500000)                                            00941001
      LIMIT = 500000                                                 00942001
      CALL MAIN1 (A,LIMIT)                                           00943001
      STOP                                                           00944001
      END                                                            00945001
```

```
/*                                                                      00946001
//*---( NEW LOAD MODULE )-----------------------------------------------00947001
//LKED.OLDLM DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)           00947101
//LKED.SYSIN DD *                                                       00949001
   INCLUDE OLDLM(JOINTX)                                                00949101
   ENTRY MAIN                                                           00949201
/*                                                                      00949301
//JOINT1   EXEC PGM=MAIN                                                00949401
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,DELETE),LABEL=(,,,IN)               00949501
//SYSPRINT DD SYSOUT=*                                                  00970000
//USERPDS  DD DSN=&&XSG70,DISP=(OLD,PASS)                               00980000
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,10)),                           00990000
//            DISP=(,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1) 01000000
//*             ++++++++++++++++++++++++++++++    INPUT CIT. DATA 70 GP.01010000
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PEE1D700),DISP=SHR,               01011000
//*             ----------------------------                            01012000
//            LABEL=(,,,IN)                                             01020000
//FT06F001 DD SYSOUT=*                                                  01030000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        01060000
//            SPACE=(TRK,(10,10)),                                      01070000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                      01080000
//FT09F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        01090000
//            SPACE=(TRK,(10,10))                                       01100000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        01110000
//            SPACE=(TRK,(10,10)),                                      01120000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                      01130000
//FT20F001 DD DUMMY                                                     01140000
//FT50F001 DD SYSOUT=*                                                  01150000
//*                                                                     01160000
//*-----------------(  CITATION  )-----------------------------------01190000
//CITATION EXEC PGM=CITATION,COND=(4,LT)                                01200000
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR                          01210000
//SYSPRINT DD SYSOUT=*                                                  01220000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                             01230000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                   01240000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01250000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01260000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01270000
//FT05F001 DD DSN=*.JOINT1.FT08F001,DISP=(OLD,DELETE)                   01280000
//FT06F001 DD SYSOUT=*                                                  01290000
//*---( OUTPUT  ZONE AVERAGED FLUX & AXIAL BUCKLING )------------***     01300000
//FT07F001 DD DSN=&&CIT,DISP=(NEW,PASS),UNIT=WORK,                      01310000
//            SPACE=(TRK,(2,1),RLSE),                                   01320000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)                      01330000
//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                             01340000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                   01350000
//*---( OUTPUT  FLUX MAP )-----------------------------------------**    01360000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               01370000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01380000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01390000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01400000
//*---( RESTART FILE )---------------------------------------------**    01410000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01420000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01430000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(2,5)),DCB=*.FT01F001               01440000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01450000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01460000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01470000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               01480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01500000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             01510000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01520000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01530000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01540000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             01550000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01560000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             01570000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01580000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01590000
//*---( MACRO CROSS SECTIONS )-------------------------------------------01600000
//FT31F001 DD DSN=*.JOINT1.FT09F001,DISP=(OLD,DELETE)                   01610000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             01620000
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             01630000
//*---( OUTPUT RESULT FILE )---------------------------------           01640000
//FT34F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               01650000
//FT51F001 DD SYSOUT=*                                                  01660000
//*                                                                     02380000
//                                                                      02410000
```

JCL file [8] .OPJCL.CNTL(GDI3PSLA)

SLAROM, 'perturbation'

```
//POC0B17P JOB (),'PTSLAROM',MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),  00010027
// CLASS=C,TIME=0025                                                    00020030
//******************************                                       00030000
//***        SLAROM          ***  FOR PERTURBATION, INC. VOID&DOPP. FUEL00040021
//******************************                                       00050000
//DATAP   EXEC PGM=DATAP                                               00060015
//STEPLIB  DD DSN=POC0H##.DATAP.LOAD,DISP=SHR,LABEL=(,,,IN)            00070017
//FT06F001 DD SYSOUT=*                                                 00080014
//*             ++++++++++++++++++++++++++  INPUT SLAROM N.D.(FUEL*3)   00110021
//FT05F001 DD DSN=POC0B17.OPDEND.DATA(GDI3PRT),DISP=SHR,               00120032
//*             --------------------------                             00121002
//            LABEL=(,,,IN)                                            00130000
//FT09F001 DD UNIT=SYSDA,DSN=&&INPUT,DISP=(,PASS),SPACE=(CYL,(1,1))    00131014
//*********************************************************************00140000
//GO      EXEC PGM=M1M                                                 00160022
//STEPLIB  DD DSN=POC0H##.SLAROM.LOAD,DISP=SHR                         00180022
//*------( INPUT PDS  )-------------------------------------------------00190000
//PDSIN    DD DUMMY                                                    00200000
//*             ++++++++++++++++++++       OUTPUT 70 GROUP PDS        00210021
//PDSOUT   DD DSN=POC0B17.@GDI3P.PDS70G,DISP=SHR                       00220033
//*             ----------------------                                 00221021
//*           DISP=(NEW,CATLG),UNIT=DASD,                              00230033
//*           DCB=(RECFM=FB,BLKSIZE=4000,LRECL=4,DSORG=PO),            00240033
//*           SPACE=(CYL,(5,1,30),RLSE)                                00250033
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),                           00270000
//            DCB=(RECFM=VSB,LRECL=32756,BLKSIZE=32760)                00280015
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00290000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001             00300000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00310000
```

```
//FT05F001 DD DDNAME=SYSIN                                              00330014
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FB,LRECL=137,BLKSIZE=1370)            00350014
//FT06F002 DD SYSOUT=*,DCB=(RECFM=FB,LRECL=137,BLKSIZE=1370)            00371014
//FT07F001 DD DUMMY                                                     00380000
//*              +++++++++++++++++++         INPUT REF. 70 GROUP MICRO00390002
//FT08F001 DD DSN=POC0H##.JFS3J3.Y9406,DISP=SHR,LABEL=(,,,IN)           00420010
//*              --------------------                                   00430002
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(10,10)),DCB=*.FT01F001             00440014
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001              00450000
//FT11F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00460000
//FT12F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00470000
//FT13F001 DD DUMMY                                                     00471014
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001              00480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00500000
//FT22F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00510000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00520000
//FT26F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00530000
//FT30F001 DD DUMMY                                                     00540000
//FT40F001 DD SYSOUT=*                                                  00550000
//FT41F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00560000
//FT42F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00570000
//FT43F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00580000
//FT55F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00590000
//FT56F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00600000
//FT59F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00610000
//FT60F001 DD SYSOUT=*                                                  00620014
//FT70F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00630000
//FT72F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00640000
//FT73F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00650000
//FT71F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00660000
//FT80F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00670000
//FT90F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00680000
//FT96F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00690000
//FT99F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001               00700000
//SYSIN    DD DSN=&&INPUT,DISP=(OLD,DELETE)                             00730015
//                                                                      02410000
```

JCL file [9] .OPJCL.CNTL(GDI3P70N)

CITATION, normal, 70 groups, 'perturbation'

```
//POC0B17P JOB (),'NEMC7GOR',MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),  00010024
// CLASS=C,TIME=0025                                                    00020026
//*                                                                     00030027
//*     JOINT UPDATE PROCESS                                           *//00040027
//*                                                                     00050027
//FORT EXEC FORTECL,PARM.FORT='NOSOURCE,LC(99)'                         00060027
//FORT.SYSIN DD *                                                       00070027
      DIMENSION A(500000)                                             00080027
      LIMIT = 500000                                                  00090027
      CALL MAIN1 (A,LIMIT)                                            00100027
      STOP                                                            00110027
      END                                                             00120027
```

```
/*                                                                      00130027
//*---( NEW LOAD MODULE )-----------------------------------------------00140027
//LKED.OLDLM DD DSN=POC0H##.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)           00150028
//LKED.SYSIN DD *                                                       00160027
   INCLUDE OLDLM(JOINT)                                                 00170028
   ENTRY MAIN                                                           00180027
/*                                                                      00190027
//JOINT1   EXEC PGM=MAIN                                                00200027
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,PASS),LABEL=(,,,IN)                 00210028
//*********************************************************************//00770000
//*     JOINT ---> CITATION                                            *//00790000
//*********************************************************************//00810000
//SYSPRINT DD SYSOUT=*                                                  00970000
//*              ++++++++++++++++++++++++++++    INPUT 70GP. MIC&MAC.   00971015
//USERPDS  DD DSN=POC0B17.@GDI3P.PDS70G,DISP=SHR                        00980032
//*              ----------------------------                           00981015
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,10)),                           00990000
//            DISP=(,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1) 01000000
//*              ++++++++++++++++++++++++++++  INPUT CIT.DATA 70GP/D&A   01010019
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PIJ3P70N),DISP=SHR,               01011030
//*              ----------------------------                           01012002
//            LABEL=(,,,IN)                                           01020000
//FT06F001 DD SYSOUT=*                                                  01030027
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        01060000
//            SPACE=(TRK,(10,10)),                                    01070000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                    01080000
//FT09F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        01090000
//            SPACE=(TRK,(10,10))                                     01100000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        01110000
//            SPACE=(TRK,(10,10)),                                    01120000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                    01130000
//FT20F001 DD DUMMY                                                     01140000
//FT50F001 DD SYSOUT=*                                                  01150000
//*                                                                     01160000
//*-----------------(  CITATION  )-----------------------------------01190000
//CITATION EXEC PGM=CITATION,COND=(4,LT)                                01200000
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR                          01210000
//SYSPRINT DD SYSOUT=*                                                  01220000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                             01230000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                 01240000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01250000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01260000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01270000
//FT05F001 DD DSN=*.JOINT1.FT08F001,DISP=(OLD,DELETE)                   01280000
//FT06F001 DD SYSOUT=*                                                  01290000
//*---( OUTPUT  ZONE AVERAGED FLUX & AXIAL BUCKLING )------------***    01300000
//FT07F001 DD DSN=&&CIT,DISP=(NEW,PASS),UNIT=WORK,                      01310000
//            SPACE=(TRK,(2,1),RLSE),                                 01320000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)                    01330000
//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                             01340000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                 01350000
//*---( OUTPUT  FLUX MAP )-----------------------------------------**    01360000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               01370000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               01380000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01390000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01400000
//*---( RESTART FILE )-------------------------------------------**    01410000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01420000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              01430000
```

```
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(2,5)),DCB=*.FT01F001                01440000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01450000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01460000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01470000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                01480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01500000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01510000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01520000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01530000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01540000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01550000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01560000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01570000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01580000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01590000
//*---( MACRO CROSS SECTIONS )-------------------------------------------01600000
//FT31F001 DD DSN=*.JOINT1.FT09F001,DISP=(OLD,DELETE)                    01610000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01620000
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01630000
//*              ++++++++++++++++++++++++  OUTPUT 70 GP FLUX DIR&ADJ.    01640019
//FT34F001 DD DSN=POC0B17.@GDI3P.FT34G70N,DISP=(NEW,CATLG),              01650032
//*              ------------------------                                01651019
//              UNIT=DASD,SPACE=(TRK,(10,10),RLSE),DCB=*.FT01F001        01652029
//FT51F001 DD SYSOUT=*                                                   01660031
//*T51F001 DD DSN=&&LIST5,DISP=(NEW,PASS),                               01661031
//*             SPACE=(CYL,(10,3)),                                      01670031
//*             DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK         01680031
//*                                                                      01690000
//*OUT5    EXEC COMPACT,PARM='TYPE2,CC=YES'                              01700031
//*TYIN    DD DSN=&&LIST5,DISP=(OLD,DELETE)                              01710031
//*-----------------(  JOINT.MIC  )-------------------------------------01720000
//JOINT2   EXEC PGM=MAIN                                                 01730028
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,PASS),LABEL=(,,,IN)                  01740028
//SYSPRINT DD SYSOUT=*                                                   01770000
//*              ++++++++++++++++++++                OUTPUT 70 GROUP FLUX01780002
//USERPDS  DD DSN=POC0B17.@GDI3P70.FLUXN,DISP=(NEW,CATLG),UNIT=DASD,     01781032
//*              --------------------                                    01782002
//        DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),                           01790000
//        SPACE=(TRK,(9,3,9),RLSE)                                       01800029
//FT01F001 DD DSN=&&CIT,DISP=(OLD,DELETE)                                01810000
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                              01820000
//*              ++++++++++++++++++++++++++     INPUT FLUX EDIT CONTROL01830002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PIJ3PF),DISP=SHR                   01831030
//*              --------------------------                              01832002
//FT06F001 DD SYSOUT=*                                                   01840000
//FT90S001 DD SYSOUT=*                                                   01850000
//*-------------------(  JOINT.MIC  )--------------------------------    01870000
//JOINT3   EXEC PGM=MAIN                                                 01880028
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,DELETE),LABEL=(,,,IN)                01890028
//SYSPRINT DD SYSOUT=*                                                   01920000
//*              ++++++++++++++++++++++      INPUT 70GP. PDS (MIC&MAC)   01921015
//PDSIN    DD DSN=POC0B17.@GDI3P.PDS70G,DISP=SHR                         01930032
//*              ----------------------                                  01931015
//*              ++++++++++++++++++++++          OUTPUT 18GP. PDS MIC&MAC01940018
//PDSOUT   DD DSN=POC0B17.@GDI3P18.PDSMICN,                              01960032
//*              ---------------------                                   01961002
//      UNIT=DASD,DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),DISP=(NEW,CATLG),  01970000
//      SPACE=(TRK,(9,3,60))                                             01980029
```



```
//*              ++++++++++++++++++++                OUTPUT 70 GROUP FLUX01990002
//USERPDS  DD DSN=POC0B17.@GDI3P70.FLUXN,DISP=SHR                        02000032
//*              --------------------                                    02001002
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                              02010000
//*              ++++++++++++++++++++++++++  INPUT CONDENSATION CONTROL02020002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PIJ3PC),DISP=SHR,                  02021030
//*              -------------------------                               02022002
//             LABEL=(,,,IN)                                             02030000
//FT06F001 DD SYSOUT=*                                                   02040000
//FT90S001 DD SYSOUT=*                                                   02050000
//                                                                       02410000
```

JCL file [10] .OPJCL.CNTL(GDI3P70V)

CITATION, void, 70 group, 'perturbation'

```
//POC0B17P JOB (),JCTFBR,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),       00010053
//         CLASS=C,TIME=0025                                             00020055
//*                                                                      00021056
//*     JOINT UPDATE PROCESS                                            *//00022056
//*                                                                      00023056
//FORT EXEC FORTECL,PARM.FORT='NOSOURCE,LC(99)'                          00024056
//FORT.SYSIN DD *                                                        00025056
      DIMENSION A(500000)                                              00026056
      LIMIT = 500000                                                   00027056
      CALL MAIN1 (A,LIMIT)                                             00028056
      STOP                                                             00029056
      END                                                              00029156
/*                                                                     00029256
//*---( NEW LOAD MODULE )-----------------------------------------------00029356
//LKED.OLDLM DD DSN=POC0H##.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)            00029456
//LKED.SYSIN DD *                                                        00029556
   INCLUDE OLDLM(JOINT)                                                00029656
   ENTRY MAIN                                                          00029756
/*                                                                     00029856
//JOINT1   EXEC PGM=MAIN                                               00029956
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,PASS),LABEL=(,,,IN)                  00030056
//*****************************************************************//00030156
//*     JOINT ---> CITATION                                           *//00040000
//*****************************************************************//00050000
//SYSPRINT DD SYSOUT=*                                                   00100000
//*              ++++++++++++++++++++++++     18 GP. PDS (MIC.&MAC.)    00101046
//USERPDS  DD DSN=POC0B17.@GDI3P.PDS70G,DISP=SHR                         00110059
//*              ------------------------                                00111046
//FT04F001 DD DISP=(,PASS),UNIT=WORK,SPACE=(TRK,(100,10)),               00120000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1)               00130000
//*              ++++++++++++++++++++++++     18 GP. CIT. INPUT DATA    00131046
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PIJ3PV70),DISP=SHR,LABEL=(,,,IN)   00140058
//*              ------------------------                                00141046
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)           00150000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                         00180000
//            SPACE=(TRK,(10,10)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)   00190000
//FT09F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                         00200000
//            SPACE=(TRK,(10,10))                                        00210000
```

```
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        00220000
//            SPACE=(TRK,(10,10)),                                      00230000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                      00240000
//FT20F001 DD DUMMY                                                     00250000
//FT50F001 DD SYSOUT=*                                                  00260000
//*-----------------(  COMPACT   )-----------------------------------00270000
//*OUT4    EXEC COMPACT,PARM='TYPE2,CC=NO'                              00280000
//*TYIN    DD DSN=&&LIST4,DISP=(OLD,DELETE)                             00290000
//*-----------------(  CITATION  )-----------------------------------00300000
//CITATION EXEC PGM=CITATION,COND=(4,LT)                                00310000
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR,LABEL=(,,,IN)            00320000
//SYSPRINT DD SYSOUT=*                                                  00330000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                             00340000
//            DCB=(RECFM=VSB,LRECL=32000,BLKSIZE=32004)                 00350000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00360000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00370000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00380000
//FT05F001 DD DSN=*.JOINT1.FT08F001,DISP=(OLD,DELETE)                   00390000
//FT06F001 DD SYSOUT=*                                                  00400000
//*---( OUTPUT  ZONE AVERAGED FLUX & AXIAL BUCKLING )------------***    00410000
//FT07F001 DD DUMMY                                                     00420000
//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                             00430000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                   00440000
//*---( OUTPUT  FLUX MAP )-----------------------------------------**   00450000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               00460000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00470000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00480000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00490000
//*---( RESTART FILE )-------------------------------------------**     00500000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00510000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00520000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(2,5)),DCB=*.FT01F001               00530000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00540000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00550000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001              00560000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001               00570000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00580000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00590000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00600000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00610000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00620000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00630000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00640000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00650000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00660000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00670000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00680000
//*---( MACRO CROSS SECTIONS )-----------------------------------------00690000
//FT31F001 DD DSN=*.JOINT1.FT09F001,DISP=(OLD,DELETE)                   00700000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00710000
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001             00720000
//*              ++++++++++++++++++++++++      OUTPUT  18 GP. FLUX     00730046
//FT34F001 DD DSN=POC0B17.@GDI3P.FT34G70V,DISP=(NEW,CATLG),             00740059
//*              ----------------------                                 00741046
//            UNIT=DASD,SPACE=(TRK,(20,10),RLSE),DCB=*.FT01F001         00750057
//FT51F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00760000
//                                                                      00770000
```


JCL file [11] .OPJCL.CNTL(GDI3P18N)

CITATION, normal, 18 groups, 'perturbation'

```
//POC0B17P JOB (),JCTFBR,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),      00010051
//         CLASS=C,TIME=0025                                            00020052
//*                                                                     00021053
//*     JOINT UPDATE PROCESS                                          *//00022053
//*                                                                     00023053
//FORT EXEC FORTECL,PARM.FORT='NOSOURCE,LC(99)'                         00024053
//FORT.SYSIN DD *                                                       00025053
      DIMENSION A(500000)                                             00026053
      LIMIT = 500000                                                  00027053
      CALL MAIN1 (A,LIMIT)                                            00028053
      STOP                                                            00029053
      END                                                             00029153
/*                                                                    00029253
//*---( NEW LOAD MODULE )---------------------------------------------00029353
//LKED.OLDLM DD DSN=POC0H##.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)           00029453
//LKED.SYSIN DD *                                                       00029553
   INCLUDE OLDLM(JOINT)                                               00029653
   ENTRY MAIN                                                         00029753
/*                                                                    00029853
//JOINT1   EXEC PGM=MAIN                                              00029953
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,DELETE),LABEL=(,,,IN)             00030053
//*******************************************************************//00030153
//*     JOINT ---> CITATION                                         *//00040000
//*******************************************************************//00050000
//SYSPRINT DD SYSOUT=*                                                  00100000
//*              ++++++++++++++++++++++      INPUT 18 GP. MIC&MAC(PDS)00101045
//USERPDS  DD DSN=POC0B17.@GDI3P18.PDSMICN,DISP=SHR                     00110057
//*              ----------------------                                 00111045
//FT04F001 DD DISP=(,PASS),UNIT=WORK,SPACE=(TRK,(100,10)),              00120000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1)              00130000
//*              ++++++++++++++++++++++++++++++INPUT 18 GP. CIT. DATA   00131045
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PIJ3PADJ),DISP=SHR,LABEL=(,,,IN)  00140056
//*              ------------------------------                         00141045
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00150000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        00180000
//            SPACE=(TRK,(10,10)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)  00190000
//FT09F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        00200000
//            SPACE=(TRK,(10,10))                                       00210000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                        00220000
//            SPACE=(TRK,(10,10)),                                      00230000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                      00240000
//FT20F001 DD DUMMY                                                     00250000
//FT50F001 DD SYSOUT=*                                                  00260000
//*-----------------(  COMPACT   )-----------------------------------00270000
//*OUT4    EXEC COMPACT,PARM='TYPE2,CC=NO'                              00280000
//*TYIN    DD DSN=&&LIST4,DISP=(OLD,DELETE)                             00290000
//*-----------------(  CITATION  )-----------------------------------00300000
//CITATION EXEC PGM=CITATION,COND=(4,LT)                                00310000
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR,LABEL=(,,,IN)            00320000
//SYSPRINT DD SYSOUT=*                                                  00330000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                             00340000
//            DCB=(RECFM=VSB,LRECL=32000,BLKSIZE=32004)                 00350000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001               00360000
```

```
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00370000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00380000
//FT05F001 DD DSN=*.JOINT1.FT08F001,DISP=(OLD,DELETE)                    00390000
//FT06F001 DD SYSOUT=*                                                   00400000
//*---( OUTPUT  ZONE AVERAGED FLUX & AXIAL BUCKLING )------------***      00410000
//FT07F001 DD DUMMY                                                      00420000
//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                              00430000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                    00440000
//*---( OUTPUT  FLUX MAP )-----------------------------------------**     00450000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                00460000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00470000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               00480000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               00490000
//*---( RESTART FILE )--------------------------------------------**     00500000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               00510000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               00520000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(2,5)),DCB=*.FT01F001                00530000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               00540000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               00550000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               00560000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                00570000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00580000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00590000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              00600000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00610000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00620000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00630000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              00640000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00650000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              00660000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00670000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                00680000
//*---( MACRO CROSS SECTIONS )-----------------------------------------00690000
//FT31F001 DD DSN=*.JOINT1.FT09F001,DISP=(OLD,DELETE)                    00700000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              00710000
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              00720000
//*            ++++++++++++++++++++++++   OUTPUT 18 GP. FLUX             00730045
//FT34F001 DD DSN=POC0B17.@GDI3P.FT34G18N,DISP=(NEW,CATLG),              00740057
//*            ----------------------                                    00741045
//            UNIT=DASD,SPACE=(TRK,(10,10),RLSE),DCB=*.FT01F001          00750054
//FT51F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)           00760000
//                                                                       00770000
```

JCL file [12] .OPJCL.CNTL(GDI3P70D)

CITATION, Doppler, 70 groups, 'perturbation'

```
//POC0B17P JOB (),'NEMC7GOR',MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),   00010025
// CLASS=C,TIME=0025                                                     00020026
//*                                                                      00030027
//*     JOINT UPDATE PROCESS                                           *//00040027
//*                                                                      00050027
//FORT EXEC FORTECL,PARM.FORT='NOSOURCE,LC(99)'                          00060027
//FORT.SYSIN DD *                                                        00070027
      DIMENSION A(500000)                                              00080027
      LIMIT = 500000                                                   00090027
      CALL MAIN1 (A,LIMIT)                                             00100027
      STOP                                                             00110027
      END                                                              00120027
/*                                                                     00130027
//*---( NEW LOAD MODULE )-----------------------------------------------00140027
//LKED.OLDLM DD DSN=POC0H##.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)            00150027
//LKED.SYSIN DD *                                                      00160027
   INCLUDE OLDLM(JOINT)                                                00170027
   ENTRY MAIN                                                          00180027
/*                                                                     00190027
//JOINT1   EXEC PGM=MAIN                                               00200027
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,PASS),LABEL=(,,,IN)                00210027
//*********************************************************************//00770000
//*     JOINT ---> CITATION                                           *//00790000
//*********************************************************************//00810000
//SYSPRINT DD SYSOUT=*                                                 00970000
//*              ++++++++++++++++++++++++++++    INPUT  70 GP.MIC&MAC  00971017
//USERPDS  DD DSN=POC0B17.@GDI3P.PDS70G,DISP=SHR                       00980030
//*              ----------------------------                          00981017
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,10)),                          00990000
//            DISP=(,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1) 01000000
//*              ++++++++++++++++++++++++++++    INPUT CIT. DATA 70 GP.01010002
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PIJ3P70D),DISP=SHR,              01011029
//*              ----------------------------                          01012002
//            LABEL=(,,,IN)                                            01020000
//FT06F001 DD DSN=&&LIST4,DISP=(NEW,PASS),                             01030000
//            SPACE=(CYL,(10,3)),                                      01040000
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK         01050000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01060000
//            SPACE=(TRK,(10,10)),                                     01070000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                     01080000
//FT09F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01090000
//            SPACE=(TRK,(10,10))                                      01100000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01110000
//            SPACE=(TRK,(10,10)),                                     01120000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                     01130000
//FT20F001 DD DUMMY                                                    01140000
//FT50F001 DD SYSOUT=*                                                 01150000
//*                                                                    01160000
//LOUT4    EXEC COMPACT,PARM='TYPE2,CC=NO'                             01170000
//UTYIN    DD DSN=&&LIST4,DISP=(OLD,DELETE)                            01180000
//*-----------------(  CITATION  )-----------------------------------01190000
//CITATION EXEC PGM=CITATION,COND=(4,LT)                               01200000
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR                         01210000
//SYSPRINT DD SYSOUT=*                                                 01220000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                           01230000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                  01240000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01250000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01260000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01270000
//FT05F001 DD DSN=*.JOINT1.FT08F001,DISP=(OLD,DELETE)                  01280000
//FT06F001 DD SYSOUT=*                                                 01290000
//*---( OUTPUT  ZONE AVERAGED FLUX & AXIAL BUCKLING )------------***    01300000
//FT07F001 DD DSN=&&CIT,DISP=(NEW,PASS),UNIT=WORK,                     01310000
//            SPACE=(TRK,(2,1),RLSE),                                  01320000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)                     01330000
//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                            01340000
```

```
//           DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                    01350000
//*---( OUTPUT  FLUX MAP )-----------------------------------------**   01360000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                01370000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01380000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01390000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01400000
//*---( RESTART FILE )---------------------------------------------**   01410000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01420000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01430000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(2,5)),DCB=*.FT01F001                01440000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01450000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01460000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01470000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                01480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01500000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01510000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01520000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01530000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01540000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01550000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01560000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01570000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01580000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01590000
//*---( MACRO CROSS SECTIONS )-------------------------------------------01600000
//FT31F001 DD DSN=*.JOINT1.FT09F001,DISP=(OLD,DELETE)                    01610000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01620000
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01630000
//*---( OUTPUT RESULT FILE )---------------------------------------       01640000
//FT34F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                01650000
//FT51F001 DD DSN=&&LIST5,DISP=(NEW,PASS),                               01660000
//            SPACE=(CYL,(10,3)),                                        01670000
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK           01680000
//*                                                                      01690000
//LOUT5    EXEC COMPACT,PARM='TYPE2,CC=YES'                              01700000
//UTYIN    DD DSN=&&LIST5,DISP=(OLD,DELETE)                              01710000
//*-----------------(  JOINT.MIC  )-------------------------------------01720000
//JOINT2   EXEC PGM=MAIN                                                 01730027
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,PASS),LABEL=(,,,IN)                  01740027
//SYSPRINT DD SYSOUT=*                                                   01770000
//*              ++++++++++++++++++++          OUTPUT 70 GROUP FLUX01780002
//USERPDS  DD DSN=POC0B17.@GDI3P70.FLUXD,DISP=(NEW,CATLG),UNIT=DASD,     01781030
//*              ----------                                              01782002
//        DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),                           01790000
//        SPACE=(TRK,(9,3,6),RLSE)                                       01800028
//FT01F001 DD DSN=&&CIT,DISP=(OLD,DELETE)                                01810000
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                              01820000
//*              ++++++++++++++++++++++++++     INPUT FLUX EDIT CONTROL01830002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PIJ3PFD),DISP=SHR                  01831029
//*              --------------------------                              01832002
//FT06F001 DD SYSOUT=*                                                   01840000
//FT90S001 DD SYSOUT=*                                                   01850000
//*--------------------(  JOINT.MIC  )-------------------------------------01870000
//JOINT2   EXEC PGM=MAIN                                                 01880027
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,DELETE),LABEL=(,,,IN)                01890027
//SYSPRINT DD SYSOUT=*                                                   01920000
//*              ++++++++++++++++++++      INPUT 70GP. PDS (MAC&MIC)    01921017
//PDSIN    DD DSN=POC0B17.@GDI3P.PDS70G,DISP=SHR                         01930030
```



```
//*              ----------                                              01931017
//*              ++++++++++++++++++++++++          OUTPUT 18GP. PDS MAC&MIC01940019
//PDSOUT   DD DSN=POC0B17.@GDI3P18.PDSMICD,                              01960030
//*              ----------                                              01961002
//      UNIT=DASD,DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),DISP=(NEW,CATLG),  01970000
//      SPACE=(TRK,(9,3,60))                                             01980028
//*              ++++++++++++++++++++                OUTPUT 70 GROUP FLUX01990002
//USERPDS  DD DSN=POC0B17.@GDI3P70.FLUXD,DISP=SHR                        02000030
//*              ----------                                              02001002
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                              02010000
//*              ++++++++++++++++++++++++++  INPUT CONDENSATION CONTROL02020002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PIJ3PCD),DISP=SHR,                 02021029
//*              --------------------------                              02022002
//            LABEL=(,,,IN)                                              02030000
//FT06F001 DD SYSOUT=*                                                   02040000
//FT90S001 DD SYSOUT=*                                                   02050000
//                                                                       02410000
```

JCL file [13] .OPJCL.CNTL(GDI3PNL)

PERKY, neutron lifetime, 'perturbation'

```
//POC0B17P JOB (),PERKY,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),        00010031
//         CLASS=C,TIME=0015                                             00020037
//* 70GP          NEUTRON  LIFETIME                                     00021026
//JOINT  EXEC PGM=JOINT                                                 00030015
//STEPLIB  DD DSN=POC0AA1.JOINTL.LOAD,DISP=SHR,LABEL=(,,,IN)            00040025
//*PSYS    DD SUBSYS=(VPCS)                                             00050000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00060000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00070000
//FT04F001 DD SPACE=(TRK,(50,5)),UNIT=WORK                              00080000
//*              ++++++++++++++++++++++++++++      INPUT PERKY DATA     00090015
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PIJ3PNL),DISP=SHR,LABEL=(,,,IN)   00100036
//*              ----------------------------                            00110015
//*              ++++++++++++++++++++++++++      INPUT 18 GP PDS FILES  00111015
//USERPDS  DD DSN=POC0B17.@GDI3P.PDS70G,DISP=SHR,LABEL=(,,,IN)          00120041
//*              ------------------------                                00141015
//*************************************************************        00150000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *INPUT DATA       * 00160000
//            SPACE=(TRK,(50,5)),DSN=&&INPUT,       *FOR NEXT JOB STEP* 00170000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *  00180000
//*************************************************************        00190000
//FT09F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS   * 00200000
//            SPACE=(TRK,(50,5)),UNIT=WORK,         *FOR NEXT JOB STEP* 00210000
//            DSN=&&BMACRO                          *BY BINARY FORM   * 00220000
//*************************************************************        00230000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *CROSS SECTIONS   * 00240000
//            SPACE=(TRK,(50,5)),DSN=&&CCROSS,      *FOR NEXT JOB STEP* 00250000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *  00260000
//*************************************************************        00270000
//FT30F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS   * 00280000
//            SPACE=(TRK,(50,5)),UNIT=WORK,         *FOR NEXT JOB STEP* 00290000
//            DSN=&&BMICRO                          *BY BINARY FORM   * 00300000
//*************************************************************        00310000
```

```
//FT40F001 DD DISP=(NEW,PASS,DELETE),              *DELAYED NEUTRON  *  00320000
//            SPACE=(TRK,(10,5)),UNIT=WORK,        *FOR NEXT JOB STEP*  00330000
//            DSN=&&BDELAY                         *BY BINARY FORM   *  00340000
//*********************************************************************  00350000
//FT50F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)            00360000
//*------------------------------------------------------------------- 00370000
//*-------------------------------------------------------------------  00381139
//*   EXPAND ABLE MEMORY SIZE                                           00381239
//*-------------------------------------------------------------------  00381339
// EXEC FORTECL,PARM.FORT='OPT(B),NOSTATIS,ELM(*),NOAE',                 00381439
//       PARM.LKED='MAP,LIST,LET,SIZE=(512K,72K)',                      00381539
//       REGION.LKED=1024K,COND.LKED=(8,LT)                             00381639
//FORT.SYSIN    DD DSN=POC0B17.OPFORT.FORT(PERK),DISP=SHR,LABEL=(,,,IN) 00381739
//LKED.OLDLM    DD DSN=POC0H##.PERKY.LOAD,DISP=SHR,LABEL=(,,,IN)        00381840
//LKED.SYSIN DD *                                                       00381939
   INCLUDE OLDLM(Y9607)                                                 00382039
   ENTRY MAIN                                                           00382139
   NAME  MAIN                                                           00382239
/*                                                                      00382339
//*-------------------------------------------------------------------  00382439
//*   GO ABLE                                                           00382539
//*-------------------------------------------------------------------  00382639
//ABLE  EXEC PGM=MAIN                                                   00382739
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,DELETE)                             00382839
//*PSYS  DD SUBSYS=(VPCS)                                               00382939
//*ERKY  EXEC PGM=Y9308,COND=(4,LT)                                     00390039
//*TEPLIB  DD DSN=POC0H##.PERKY.LOAD,DISP=SHR                           00400039
//**SYS    DD SUBSYS=(VPCS)                                             00410039
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00420000
//*              ++++++++++++++++++++++++++        INPUT 18 GP FLUX D&A00430015
//FT01F001 DD DSN=POC0B17.@GDI3P.FT34G70N,DISP=SHR,LABEL=(,,,IN)        00440041
//*              -------------------------                              00450015
//FT02F001 DD UNIT=WORK,SPACE=(TRK,(100,100)),DCB=(BLKSIZE=18628)       00460035
//FT03F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00470000
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00480000
//FT05F001 DD DSN=*.JOINT.FT08F001,DISP=(OLD,DELETE)                    00490000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00500000
//FT08F001 DD DSN=*.JOINT.FT09F001,DISP=(OLD,DELETE)                    00510000
//FT10F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00520000
//FT11F001 DD DSN=*.JOINT.FT30F001,DISP=(OLD,DELETE)                    00530000
//FT13F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00540000
//FT14F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00550000
//FT15F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00560000
//FT16F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00570000
//FT17F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00580000
//FT18F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00590000
//FT19F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00600000
//FT21F001 DD DSN=*.JOINT.FT40F001,DISP=(OLD,DELETE)                    00610000
//FT22F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00620000
//*              ++++++++++++++++++++++++++   INPUT 18 GP. UNPERT. FLUX 00630019
//FT23F001 DD DSN=POC0B17.@GDI3P.FT34G70N,DISP=SHR,LABEL=(,,,IN)        00640041
//*              -------------------------                              00641015
//*FT23F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001            00650000
//*------------------------------------------------------------------- 00660000
//FT31F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00670000
//FT32F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00680000
//FT41F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00690000
//FT42F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00700000
//                                                                      00710011
```



```
//********************************************************************* 00720011
//LSTPKY EXEC PGM=LSTPKY,COND=(4,LT)                                    00730009
//STEPLIB  DD DSN=POC0AA1.INTERF.LOAD,DISP=SHR                          00740009
//*PSYS    DD SUBSYS=(VPCS)                                             00750009
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00760009
//FT05F001 DD DUMMY                                                     00770009
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00780009
//                                                                      00790000
```

JCL file [14] .OPJCL.CNTL(GDI3PDNF)

PERKY, delayed neutron fraction, 'perturbation'

```
//POC0B17P JOB (),PERKY,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),       00010039
//         CLASS=C,TIME=0005                                            00020041
//* 18GP             DELAYED NEUTRON FRACTION                          00021027
//JOINT  EXEC PGM=JOINT                                                00030015
//STEPLIB  DD DSN=POC0AA1.JOINTL.LOAD,DISP=SHR,LABEL=(,,,IN)           00040025
//*PSYS    DD SUBSYS=(VPCS)                                            00050000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)         00060000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)         00070000
//FT04F001 DD SPACE=(TRK,(50,5)),UNIT=WORK                             00080000
//*              ++++++++++++++++++++++++++++       INPUT PERKY DATA   00090015
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PIJ3PDNX),DISP=SHR,LABEL=(,,,IN) 00100043
//*              ----------------------------                           00110015
//*              ++++++++++++++++++++++++       INPUT 18 GP PDS FILES  00111015
//USERPDS  DD DSN=POC0B17.@GDI3P18.PDSMICN,DISP=SHR,LABEL=(,,,IN)       00120045
//MICROPDS DD DSN=POC0B17.@GDI3P18.PDSMICN,DISP=SHR,LABEL=(,,,IN)       00130045
//*              ------------------------                               00141015
//*********************************************************************  00150000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *INPUT DATA       *  00160000
//            SPACE=(TRK,(50,5)),DSN=&&INPUT,       *FOR NEXT JOB STEP*  00170000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *  00180000
//*********************************************************************  00190000
//FT09F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS   *  00200000
//            SPACE=(TRK,(50,5)),UNIT=WORK,         *FOR NEXT JOB STEP*  00210000
//            DSN=&&BMACRO                          *BY BINARY FORM   *  00220000
//*********************************************************************  00230000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *CROSS SECTIONS   *  00240000
//            SPACE=(TRK,(50,5)),DSN=&&CCROSS,      *FOR NEXT JOB STEP*  00250000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *  00260000
//*********************************************************************  00270000
//FT30F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS   *  00280000
//            SPACE=(TRK,(50,5)),UNIT=WORK,         *FOR NEXT JOB STEP*  00290000
//            DSN=&&BMICRO                          *BY BINARY FORM   *  00300000
//*********************************************************************  00310000
//FT40F001 DD DISP=(NEW,PASS,DELETE),               *DELAYED NEUTRON  *  00320000
//            SPACE=(TRK,(10,5)),UNIT=WORK,         *FOR NEXT JOB STEP*  00330000
//            DSN=&&BDELAY                          *BY BINARY FORM   *  00340000
//*********************************************************************  00350000
//FT50F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00360000
//*------------------------------------------------------------------- 00370000
//*-------------------------------------------------------------------  00381144
//*   EXPAND PERKY MEMORY SIZE                                          00381244
```

```
//*-------------------------------------------------------------------  00381344
// EXEC FORTECL,PARM.FORT='OPT(B),NOSTATIS,ELM(*),NOAE',               00381444
//       PARM.LKED='MAP,LIST,LET,SIZE=(512K,72K)',                    00381544
//       REGION.LKED=1024K,COND.LKED=(8,LT)                           00381644
//FORT.SYSIN    DD DSN=POC0B17.OPFORT.FORT(PERK),DISP=SHR,LABEL=(,,,IN) 00381744
//LKED.OLDLM    DD DSN=POC0H##.PERKY.LOAD,DISP=SHR,LABEL=(,,,IN)       00381844
//LKED.SYSIN DD *                                                     00381944
   INCLUDE OLDLM(Y9607)                                               00382044
   ENTRY MAIN                                                         00382144
   NAME  MAIN                                                         00382244
/*                                                                    00382344
//*-------------------------------------------------------------------  00382444
//*   GO PERKY                                                        00382544
//*-------------------------------------------------------------------  00382644
//PERKY  EXEC PGM=MAIN                                                00382744
//STEPLIB  DD DSN=&&GOSET,DISP=(OLD,DELETE)                           00382844
//*ERKY  EXEC PGM=Y9308,COND=(4,LT)                                   00390044
//*TEPLIB  DD DSN=POC0B15.PERKY.LOAD,DISP=SHR                         00400044
//*PSYS    DD SUBSYS=(VPCS)                                           00410000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)        00420000
//*              ++++++++++++++++++++++++++          INPUT 18 GP FLUX D&A00430015
//FT01F001 DD DSN=POC0B17.@GDI3P.FT34G18N,DISP=SHR,LABEL=(,,,IN)      00440045
//*              -------------------------                            00450015
//FT02F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=(BLKSIZE=18628)      00460000
//FT03F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00470000
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00480000
//FT05F001 DD DSN=*.JOINT.FT08F001,DISP=(OLD,DELETE)                  00490000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)        00500000
//FT08F001 DD DSN=*.JOINT.FT09F001,DISP=(OLD,DELETE)                  00510000
//FT10F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00520000
//FT11F001 DD DSN=*.JOINT.FT30F001,DISP=(OLD,DELETE)                  00530000
//FT13F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00540029
//FT14F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00550000
//FT15F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00560000
//FT16F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00570000
//FT17F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00580000
//FT18F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00590000
//FT19F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00600000
//FT21F001 DD DSN=*.JOINT.FT40F001,DISP=(OLD,DELETE)                  00610000
//FT22F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00620000
//*              ++++++++++++++++++++++++++   INPUT 18 GP. UNPERT. FLUX 00630019
//FT23F001 DD DSN=POC0B17.@GDI3P.FT34G18N,DISP=SHR,LABEL=(,,,IN)      00640045
//*              -------------------------                            00641015
//*FT23F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001          00650000
//*-------------------------------------------------------------------  00660000
//FT31F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00670000
//FT32F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00680000
//FT41F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00690000
//FT42F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001           00700000
//                                                                    00710011
//********************************************************************* 00720011
//LSTPKY EXEC PGM=LSTPKY,COND=(4,LT)                                  00730009
//STEPLIB  DD DSN=POC0AA1.INTERF.LOAD,DISP=SHR                        00740009
//*PSYS    DD SUBSYS=(VPCS)                                           00750009
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)        00760009
//FT05F001 DD DUMMY                                                   00770009
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)        00780009
//                                                                    00790000
```


JCL file [15] .OPJCL.CNTL(GDI3PEV)

PERKY, Na void, 'perturbation'

```
//POC0B17P JOB (),PERKY,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),     00010032
//         CLASS=C,TIME=0005                                          00020034
//*   70 GP. NA VOID PERTURBATION , EXACT                            00021025
//JOINT  EXEC PGM=JOINT                                              00030015
//STEPLIB  DD DSN=POC0AA1.JOINTL.LOAD,DISP=SHR,LABEL=(,,,IN)         00040027
//*PSYS    DD SUBSYS=(VPCS)                                          00050000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)       00060000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)       00070000
//FT04F001 DD SPACE=(TRK,(50,5)),UNIT=WORK                           00080000
//*              ++++++++++++++++++++++++++++       INPUT PERKY DATA  00090015
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PIJ3PEV),DISP=SHR,LABEL=(,,,IN) 00100033
//*              ----------------------------                        00110015
//*              ++++++++++++++++++++++++       INPUT 18 GP PDS FILES 00111015
//USERPDS  DD DSN=POC0B17.@GDI3P.PDS70G,DISP=SHR,LABEL=(,,,IN)       00120035
//*              ------------------------                            00141015
//*******************************************************************  00150000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *INPUT DATA       *  00160000
//            SPACE=(TRK,(50,5)),DSN=&&INPUT,      *FOR NEXT JOB STEP*  00170000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *  00180000
//*******************************************************************  00190000
//FT09F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS   *  00200000
//            SPACE=(TRK,(50,5)),UNIT=WORK,        *FOR NEXT JOB STEP*  00210000
//            DSN=&&BMACRO                         *BY BINARY FORM   *  00220000
//*******************************************************************  00230000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *CROSS SECTIONS   *  00240000
//            SPACE=(TRK,(50,5)),DSN=&&CCROSS,     *FOR NEXT JOB STEP*  00250000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *  00260000
//*******************************************************************  00270000
//FT30F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS   *  00280000
//            SPACE=(TRK,(50,5)),UNIT=WORK,        *FOR NEXT JOB STEP*  00290000
//            DSN=&&BMICRO                         *BY BINARY FORM   *  00300000
//*******************************************************************  00310000
//FT40F001 DD DISP=(NEW,PASS,DELETE),               *DELAYED NEUTRON  *  00320000
//            SPACE=(TRK,(10,5)),UNIT=WORK,        *FOR NEXT JOB STEP*  00330000
//            DSN=&&BDELAY                         *BY BINARY FORM   *  00340000
//*******************************************************************  00350000
//FT50F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)       00360000
//*-------------------------------------------------------------------  00370000
//PERKY  EXEC PGM=Y9308,COND=(4,LT)                                  00380000
//STEPLIB  DD DSN=POC0AA1.PERKYL.LOAD,DISP=SHR                       00400024
//*PSYS    DD SUBSYS=(VPCS)                                          00410000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)       00420000
//*              ++++++++++++++++++++++++++          INPUT 18 GP FLUX D&A00430015
//FT01F001 DD DSN=POC0B17.@GDI3P.FT34G70N,DISP=SHR,LABEL=(,,,IN)     00440035
//*              -------------------------                           00450015
//FT02F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=(BLKSIZE=18628)     00460000
//FT03F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001          00470000
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001          00480000
//FT05F001 DD DSN=*.JOINT.FT08F001,DISP=(OLD,DELETE)                 00490000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)       00500000
//FT08F001 DD DSN=*.JOINT.FT09F001,DISP=(OLD,DELETE)                 00510000
//FT10F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001          00520000
//FT11F001 DD DSN=*.JOINT.FT30F001,DISP=(OLD,DELETE)                 00530000
```

```
//FT13F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00540000
//FT14F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00550000
//FT15F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00560000
//FT16F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00570000
//FT17F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00580000
//FT18F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00590000
//FT19F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00600000
//FT21F001 DD DSN=*.JOINT.FT40F001,DISP=(OLD,DELETE)                       00610000
//FT22F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00620000
//*              ++++++++++++++++++++++++++     INPUT 18 GP. PERT. FLUX  00630015
//FT23F001 DD DSN=POC0B17.@GDI3P.FT34G70V,DISP=SHR,LABEL=(,,,IN)           00640035
//*              --------------------------                                00641015
//*FT23F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001               00650000
//*--------------------------------------------------------------------    00660000
//FT31F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00670000
//FT32F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00680000
//FT41F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00690000
//FT42F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00700000
//                                                                         00710011
//*********************************************************************** 00720011
//LSTPKY EXEC PGM=LSTPKY,COND=(4,LT)                                       00730009
//STEPLIB  DD DSN=POC0AA1.INTERF.LOAD,DISP=SHR                             00740009
//*PSYS    DD SUBSYS=(VPCS)                                                00750009
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00760009
//FT05F001 DD DUMMY                                                        00770009
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00780009
//                                                                         00790000
```


JCL file [16] .OPJCL.CNTL(GDI3PFD0)

PERKY, Doppler (by zone), 'perturbation'

```
//POC0B17P JOB (),PERKY,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),          00010027
//         CLASS=C,TIME=0015                                               00020028
//*        DOPPLER PERTURBATION, I'ST ORDER, BY REGION                     00021021
//JOINT  EXEC PGM=JOINT                                                    00030015
//STEPLIB  DD DSN=POC0H##.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)                00040022
//*PSYS    DD SUBSYS=(VPCS)                                                00050000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00060000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00070000
//FT04F001 DD SPACE=(TRK,(50,5)),UNIT=WORK                                 00080000
//*              ++++++++++++++++++++++++++++++       INPUT PERKY DATA     00090015
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PIJ3PFD0),DISP=SHR,LABEL=(,,,IN)     00100028
//*              ----------------------------                              00110015
//*              ++++++++++++++++++++++++       INPUT 18 GP PDS FILES     00111015
//USERPDS  DD DSN=POC0B17.@GDI3P18.PDSMICN,DISP=SHR,LABEL=(,,,IN)          00120030
//         DD DSN=POC0B17.@GDI3P18.PDSMICD,DISP=SHR,LABEL=(,,,IN)          00130030
//*              ------------------------                                  00141015
//*********************************************************************** 00150000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *INPUT DATA       *   00160000
//            SPACE=(TRK,(50,5)),DSN=&&INPUT,       *FOR NEXT JOB STEP*   00170000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *    00180000
//*********************************************************************** 00190000
//FT09F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS   *   00200000
//            SPACE=(TRK,(50,5)),UNIT=WORK,         *FOR NEXT JOB STEP*   00210000
//            DSN=&&BMACRO                          *BY BINARY FORM   *   00220000
//*********************************************************************** 00230000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *CROSS SECTIONS   *   00240000
//            SPACE=(TRK,(50,5)),DSN=&&CCROSS,      *FOR NEXT JOB STEP*   00250000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *    00260000
//*********************************************************************** 00270000
//FT30F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS   *   00280000
//            SPACE=(TRK,(50,5)),UNIT=WORK,         *FOR NEXT JOB STEP*   00290000
//            DSN=&&BMICRO                          *BY BINARY FORM   *   00300000
//*********************************************************************** 00310000
//FT40F001 DD DISP=(NEW,PASS,DELETE),               *DELAYED NEUTRON  *   00320000
//            SPACE=(TRK,(10,5)),UNIT=WORK,         *FOR NEXT JOB STEP*   00330000
//            DSN=&&BDELAY                          *BY BINARY FORM   *   00340000
//*********************************************************************** 00350000
//FT50F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00360000
//*--------------------------------------------------------------------    00370000
//PERKY  EXEC PGM=Y9607,COND=(4,LT)                                        00380029
//STEPLIB  DD DSN=POC0H##.PERKY.LOAD,DISP=SHR                              00400029
//*PSYS    DD SUBSYS=(VPCS)                                                00410000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00420000
//*              ++++++++++++++++++++++++++          INPUT 18 GP FLUX D&A 00430015
//FT01F001 DD DSN=POC0B17.@GDI3P.FT34G18N,DISP=SHR,LABEL=(,,,IN)           00440030
//*              --------------------------                                00450015
//FT02F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=(BLKSIZE=18628)           00460000
//FT03F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00470000
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00480000
//FT05F001 DD DSN=*.JOINT.FT08F001,DISP=(OLD,DELETE)                       00490000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00500000
//FT08F001 DD DSN=*.JOINT.FT09F001,DISP=(OLD,DELETE)                       00510000
//FT10F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00520000
//FT11F001 DD DSN=*.JOINT.FT30F001,DISP=(OLD,DELETE)                       00530000
//FT13F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00540000
//FT14F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00550000
//FT15F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00560000
//FT16F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00570000
//FT17F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00580000
//FT18F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00590000
//FT19F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00600000
//FT21F001 DD DSN=*.JOINT.FT40F001,DISP=(OLD,DELETE)                       00610000
//FT22F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00620000
//*              ++++++++++++++++++++++++++    INPUT 18 GP. UNPERT. FLUX  00630019
//FT23F001 DD DSN=POC0B17.@GDI3P.FT34G18N,DISP=SHR,LABEL=(,,,IN)           00640030
//*              --------------------------                                00641015
//*FT23F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001               00650000
//*--------------------------------------------------------------------    00660000
//FT31F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00670000
//FT32F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00680000
//FT41F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00690000
//FT42F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001                00700000
//                                                                         00710011
//*********************************************************************** 00720011
//LSTPKY EXEC PGM=LSTPKY,COND=(4,LT)                                       00730009
//STEPLIB  DD DSN=POC0AA1.INTERF.LOAD,DISP=SHR                             00740009
//*PSYS    DD SUBSYS=(VPCS)                                                00750009
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00760009
//FT05F001 DD DUMMY                                                        00770009
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)             00780009
//                                                                         00790000
```

JCL file [17] .OPJCL.CNTL(GDI3PFD1)

PERKY, Doppler (by nuclide), 'perturbation'

```
//POC0B17P JOB (),PERKY,MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),        00010029
//         CLASS=C,TIME=0015                                             00020032
//*       DOPPLER PERTURBATION, 1'ST ORDER, BY ISOTOPE - GROUP 1         00021023
//JOINT  EXEC PGM=JOINT                                                 00030015
//STEPLIB  DD DSN=POC0H##.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)             00040022
//*PSYS    DD SUBSYS=(VPCS)                                             00050000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00060000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00070000
//FT04F001 DD SPACE=(TRK,(50,5)),UNIT=WORK                              00080000
//*              ++++++++++++++++++++++++++++++      INPUT PERKY DATA    00090015
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(GDI3PFD1),DISP=SHR,LABEL=(,,,IN)  00100033
//*              .----------------------------                          00110015
//*              ++++++++++++++++++++++++++      INPUT 18 GP PDS FILES  00111015
//USERPDS  DD DSN=POC0B17.@GDI3P18.PDSMICN,DISP=SHR,LABEL=(,,,IN)       00120033
//         DD DSN=POC0B17.@GDI3P18.PDSMICD,DISP=SHR,LABEL=(,,,IN)       00130033
//MICROPDS DD DSN=POC0B17.@GDI3P18.PDSMICN,DISP=SHR,LABEL=(,,,IN)       00140033
//         DD DSN=POC0B17.@GDI3P18.PDSMICD,DISP=SHR,LABEL=(,,,IN)       00140133
//*              ----------------------                                 00141015
//*************************************************************        00150000
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *INPUT DATA      *  00160000
//            SPACE=(TRK,(50,5)),DSN=&&INPUT,       *FOR NEXT JOB STEP*  00170000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *  00180000
//*************************************************************        00190000
//FT09F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS  *  00200000
//            SPACE=(TRK,(50,5)),UNIT=WORK,         *FOR NEXT JOB STEP*  00210000
//            DSN=&&BMACRO                          *BY BINARY FORM  *   00220000
//*************************************************************        00230000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=WORK,     *CROSS SECTIONS  *  00240000
//            SPACE=(TRK,(50,5)),DSN=&&CCROSS,      *FOR NEXT JOB STEP*  00250000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=6240) *BY CARD FORM     *  00260000
//*************************************************************        00270000
//FT30F001 DD DISP=(NEW,PASS,DELETE),               *CROSS SECTIONS  *  00280000
//            SPACE=(TRK,(50,5)),UNIT=WORK,         *FOR NEXT JOB STEP*  00290000
//            DSN=&&BMICRO                          *BY BINARY FORM  *   00300000
//*************************************************************        00310000
//FT40F001 DD DISP=(NEW,PASS,DELETE),               *DELAYED NEUTRON *  00320000
//            SPACE=(TRK,(10,5)),UNIT=WORK,         *FOR NEXT JOB STEP*  00330000
//            DSN=&&BDELAY                          *BY BINARY FORM  *   00340000
//*************************************************************        00350000
//FT50F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00360000
//*-------------------------------------------------------------------- 00370000
//PERKY  EXEC PGM=Y9308,COND=(4,LT)                                     00380000
//STEPLIB  DD DSN=POC0AA1.PERKYL.LOAD,DISP=SHR                          00400024
//*PSYS    DD SUBSYS=(VPCS)                                             00410000
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00420000
//*              ++++++++++++++++++++++++++          INPUT 18 GP FLUX D&A00430015
//FT01F001 DD DSN=POC0B17.@GDI3P.FT34G18N,DISP=SHR,LABEL=(,,,IN)        00440033
//*              ------------------------                               00450015
//FT02F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=(BLKSIZE=18628)        00460000
//FT03F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00470000
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00480000
//FT05F001 DD DSN=*.JOINT.FT08F001,DISP=(OLD,DELETE)                    00490000
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00500000
//FT08F001 DD DSN=*.JOINT.FT09F001,DISP=(OLD,DELETE)                    00510000
//FT10F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00520000
//FT11F001 DD DSN=*.JOINT.FT30F001,DISP=(OLD,DELETE)                    00530000
//FT13F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00540000
//FT14F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00550000
//FT15F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00560000
//FT16F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00570000
//FT17F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00580000
//FT18F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00590000
//FT19F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00600000
//FT21F001 DD DSN=*.JOINT.FT40F001,DISP=(OLD,DELETE)                    00610000
//FT22F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00620000
//*              ++++++++++++++++++++++++++    INPUT 18 GP. UNPERT. FLUX 00630030
//FT23F001 DD DSN=POC0B17.@GDI3P.FT34G18N,DISP=SHR,LABEL=(,,,IN)        00640033
//*              ------------------------                               00641015
//*FT23F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001            00650000
//*-------------------------------------------------------------------- 00660000
//FT31F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00670000
//FT32F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00680000
//FT41F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00690000
//FT42F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001             00700000
//                                                                      00710011
//********************************************************************* 00720011
//LSTPKY EXEC PGM=LSTPKY,COND=(4,LT)                                    00730009
//STEPLIB  DD DSN=POC0AA1.INTERF.LOAD,DISP=SHR                          00740009
//*PSYS    DD SUBSYS=(VPCS)                                             00750009
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00760009
//FT05F001 DD DUMMY                                                     00770009
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)          00780009
//                                                                      00790000
```

JCL file [18] .OPEDID.DATA(DUMPGDI1)

Read PDS (fission spectrum), 'rod worth' or 'shutdown margin'

```
//POC0B17X JOB (),MSGCLASS=X,MSGLEVEL=(2,0),NOTIFY=POC0B17,             00000010
// CLASS=B,TIME=0005                                                    00000011
//PDSDUMP EXEC FORTECLG,PARM.FORT='NOSOURCE'                            00131000
//FORT.SYSIN DD *                                                       00132028
      SUBROUTINE PUTIDX(NMPDS,NMCELL,NMPROG,ITITLE,MAXG,IDS,IPL,MAXM,   00000100
     +                  MAXI,NMIC,NMICRO,NUCN,NMNUC,DENHOM,IDATE,       00000200
     +                  ENBND )                                         00000300
C                                                                       00000400
C           THIS SUBROUTINE DOES I/O OF ID DATA                         00000500
C                                                                       00000600
C   ARGUMENT LIST                                                       00000700
C     NMPDS(2) -------- DATA SET NAME OF PDS FILE                       00000800
C     NMCELL(2) ------- REGION NAME                                     00000900
C     NMPROG ---------- PROCESSED PROGRAM NAME                         00001000
C     ITITLE(18) ------ TITLE DATA                                      00001100
C     MAXG ------------ NO. OF ENERGY GROUP                           00001200
C     IDS ------------- NO. OF SINK GROUP                              00001300
C     IPL ------------- HIGHEST ORDER OF LEGENDRE EXPANSION            00001400
```

```
C     MAXM ------------ TOTAL LENGTH OF MACROSCOPIC CROSS SECTION DATA  00001500
C     MAXI ------------ TOTAL LENGTH OF MICROSCOPIC CROSS SECTION DATA  00001600
C     NMIC ------------ NO. OF MATERIAL WHITCH IS INCLUDED IN NMICRO    00001700
C     NMICRO(NMIC) ---- MATERIAL CODE NAME (OUTPUT)                     00001800
C     NUCN ------------ NUCLEAR NO.                                     00001900
C     NMNUC(NUCN) ----- MATERIAL CODE NAME (ALL)                        00002000
C     DENHOM(NUCN) ---- HOMOGENIZED NO. DENSITY (ALL)                   00002100
C     IDATE(2) -------- PROCESSED DATE (CHARACTOR)                      00002200
C     ENBND ----------- ENERGY BOUNDARY                                 00002300
C                                                                       00002400
      DIMENSION NMPDS(2),NMCELL(2),ITITLE(18),NMICRO(1),NMNUC(1)        00002500
C$    DIMENSION DENHOM(1),IDATE(2),MEMB(2),IWORK(250),WORK(250)         00002601
      DIMENSION DENHOM(1),IDATE(2),MEMB(2),IWORK(500),WORK(500)         00002701
      DIMENSION ENBND(1)                                                00002801
      EQUIVALENCE (IWORK(1),WORK(1))                                    00002901
C+    DATA MAXL /250/ (93/07/06)                                        00003001
      DATA MAXL /500/                                                   00003101
C                                                                       00003201
      LENG = 27+NMIC+2*NUCN                                             00003301
      IF (LENG.GT.MAXL) GO TO 7100                                      00003401
      CALL NAMSET (NMCELL,NMPROG,NMMIC,NMIC,NMICRO,1,MEMB)              00003501
C                                                                       00003601
C                        RECORDING DATA SETUP                           00003701
      IWORK(1) = MAXG                                                   00003801
      IWORK(2) = IDS                                                    00003901
      IWORK(3) = IPL                                                    00004001
      IWORK(4) = MAXM                                                   00004101
      IWORK(5) = MAXI                                                   00004201
      IWORK(6) = NMIC                                                   00004301
      IWORK(7) = NUCN                                                   00004401
      CALL DATE (IWORK(8))                                              00004501
      DO 10 I=1,18                                                      00004601
      IWORK(I+9) = ITITLE(I)                                            00004701
   10 CONTINUE                                                          00004801
      IF(NMIC.LE.0)  GO TO 30                                           00004901
      DO 20 I=1,NMIC                                                    00005001
      IWORK(I+27) = NMICRO(I)                                           00005101
   20 CONTINUE                                                          00005201
   30 CONTINUE                                                          00005301
      NW = 27 + NMIC                                                    00005401
      IF (NUCN.LE.0) GO TO 60                                           00005501
      DO 40 I=1,NUCN                                                    00005601
      IWORK(I+NW) = NMNUC(I)                                            00005701
   40 CONTINUE                                                          00005801
      NW = NW+NUCN                                                      00005901
      DO 50 I=1,NUCN                                                    00006001
      WORK(I+NW) = DENHOM(I)                                            00006101
   50 CONTINUE                                                          00006201
      NW = NW+NUCN                                                      00006301
   60 CONTINUE                                                          00006401
      DO 61 I=1,MAXG+1                                                  00006501
      NW = NW +1                                                        00006601
      WORK(NW) = ENBND(I)                                               00006701
   61 CONTINUE                                                          00006801
      CALL PDSPUT (NMPDS,MEMB,IWORK,NW)                                 00006901
      GO TO 9999                                                        00007001
C                                                                       00007101
      ENTRY GETIDX(NMPDS,NMCELL,NMPROG,ITITLE,MAXG,IDS,IPL,MAXM,        00007201
     +             MAXI,NMIC,NMICRO,NUCN,NMNUC,DENHOM,IDATE,            00007301
     +             ENBND)                                               00007401
C                                                                       00007501
C      READ ID DATA FROM PDS FILE                                       00007601
      NMIC = 1                                                          00007701
      CALL NAMSET (NMCELL,NMPROG,NMMIC,NMIC,NMICRO,1,MEMB)              00007801
      CALL PDSLEN (NMPDS,MEMB,LENG)                                     00007901
      IF (LENG.LT.0) GO TO 7000                                         00008001
      IF (LENG.GT.MAXL) GO TO 7100                                      00008101
      CALL PDSGET (NMPDS,MEMB,IWORK,LENG)                               00008201
      MAXG = IWORK(1)                                                   00008301
      MAXGW = IWORK(1)                                                  00008401
      IDS = IWORK(2)                                                    00008501
      IPL = IWORK(3)                                                    00008601
      MAXM = IWORK(4)                                                   00008701
      MAXI = IWORK(5)                                                   00008801
      NMIC = IWORK(6)                                                   00008901
      NMICW = IWORK(6)                                                  00009001
      NUCN = IWORK(7)                                                   00009101
      NUCNW = IWORK(7)                                                  00009201
      IDATE(1) = IWORK(8)                                               00009301
      IDATE(2) = IWORK(9)                                               00009401
      DO 70 I=1,18                                                      00009501
      ITITLE(I) = IWORK(I+9)                                            00009601
   70 CONTINUE                                                          00009701
      IF (NMICW.LE.0) GO TO 90                                          00009801
      DO 80 I=1,NMICW                                                   00009901
      NMICRO(I) = IWORK(I+27)                                           00010001
   80 CONTINUE                                                          00010101
   90 CONTINUE                                                          00010201
      IPOS = 27 + NMICW                                                 00010301
      IF (NUCNW.LE.0) GO TO 120                                         00010401
      NW = 27+NMICW                                                     00010501
      DO 100 I=1,NUCNW                                                  00010601
      NMNUC(I) = IWORK(I+NW)                                            00010701
  100 CONTINUE                                                          00010801
      NW = NW+NUCNW                                                     00010901
      DO 110 I=1,NUCNW                                                  00011001
      DENHOM(I) = WORK(I+NW)                                            00011101
  110 CONTINUE                                                          00011201
      IPOS = NW + NUCNW                                                 00011301
  120 CONTINUE                                                          00011401
      DO 140 I=1,MAXGW+1                                                00011501
      ENBND(I) = WORK(I+IPOS)                                           00011601
  140 CONTINUE                                                          00011701
      GO TO 9999                                                        00011801
C                                                                       00011901
      ENTRY FNDIDX(NMPDS,NMCELL,NMPROG,NLENG ,                          00012001
     *             MAXG ,IDS  ,IPL  ,NMIC   ,NUCN )                    00012101
C                                                                       00012201
C      FIND ID DATA FROM PDS FILE                                       00012301
       MAXG  = 0                                                        00012401
       IDS   = 0                                                        00012501
       IPL   = 0                                                        00012601
       NMIC  = 0                                                        00012701
       NUCN  = 0                                                        00012801
      CALL NAMSET (NMCELL,NMPROG,0    ,1   ,0     ,1,MEMB)             00012901
      CALL PDSLEN (NMPDS,MEMB,NLENG)                                    00013001
      IF (NLENG .LE. 0 ) GO TO 9999                                     00013101
      CALL PDSGET(NMPDS,MEMB,IWORK,7)                                   00013201
```

```
      MAXG  = IWORK(1)                                                  00013301
      IDS   = IWORK(2)                                                  00013401
      IPL   = IWORK(3)                                                  00013501
      NMIC  = IWORK(6)                                                  00013601
      NUCN  = IWORK(7)                                                  00013701
      GO TO 9999                                                        00013801
C                                                                       00013901
 7000 CONTINUE                                                          00014001
      WRITE (6,7010) MEMB                                               00014101
 7010 FORMAT ('0***** ERROR    MEMBER NAME ''',2A4,''' DOES NOT EXIST') 00014201
      STOP 100                                                          00014301
C                                                                       00014401
 7100 CONTINUE                                                          00014501
      WRITE (6,65) MAXL,LENG                                            00014601
   65 FORMAT ('0***** ERROR AREA SIZE IS TOO SMALL *****',              00014701
     1        /,' ',T20,'RESERVED AREA IS ',I5,' WORDS',               00014801
     2        /,' ',T20,'REQUIRED AREA IS ',I5,' WORDS')               00014901
      STOP 110                                                          00015001
C                                                                       00015101
 9999 CONTINUE                                                          00015201
      RETURN                                                            00015301
      END                                                               00015401
      SUBROUTINE PUTID (NMPDS,NMCELL,NMPROG,ITITLE,MAXG,IDS,IPL,MAXM,   00000100
     +                  MAXI,NMIC,NMICRO,NUCN,NMNUC,DENHOM)             00000200
C                                                                       00000300
C          THIS SUBROUTINE DOES I/O OF ID DATA                          00000400
C                                                                       00000500
C   ARGUMENT LIST                                                       00000600
C     NMPDS(2) -------- DATA SET NAME OF PDS FILE                       00000700
C     NMCELL(2) ------- REGION NAME                                     00000800
C     NMPROG ---------- PROCESSED PROGRAM NAME                         00000900
C     ITITLE(18) ------ TITLE DATA                                      00001000
C     MAXG ------------ NO. OF ENERGY GROUP                           00001100
C     IDS ------------- NO. OF SINK GROUP                              00001200
C     IPL ------------- HIGHEST ORDER OF LEGENDRE EXPANSION            00001300
C     MAXM ------------ TOTAL LENGTH OF MACROSCOPIC CROSS SECTION DATA 00001400
C     MAXI ------------ TOTAL LENGTH OF MICROSCOPIC CROSS SECTION DATA 00001500
C     NMIC ------------ NO. OF MATERIAL WHITCH IS INCLUDED IN NMICRO   00001600
C     NMICRO(NMIC) ---- MATERIAL CODE NAME (OUTPUT)                     00001700
C     NUCN ------------ NUCLEAR NO.                                    00001800
C     NMNUC(NUCN) ----- MATERIAL CODE NAME (ALL)                        00001900
C     DENHOM(NUCN) ---- HOMOGENIZED NO. DENSITY (ALL)                   00002000
C     IDATE(2) -------- PROCESSED DATE (CHARACTOR)                      00002100
C                                                                       00002200
      DIMENSION NMPDS(2),NMCELL(2),ITITLE(18),NMICRO(1),NMNUC(1)        00002300
C$    DIMENSION DENHOM(1),IDATE(2),MEMB(2),IWORK(250),WORK(250)         00002401
      DIMENSION DENHOM(1),IDATE(2),MEMB(2),IWORK(500),WORK(500)         00002501
      EQUIVALENCE (IWORK(1),WORK(1))                                    00002601
C+&&& DATA MAXL /250/ (93/07/06)                                        00002701
      DATA MAXL /500/                                                   00002801
C                                                                       00002901
      LENG = 27+NMIC+2*NUCN                                             00003001
      IF (LENG.GT.MAXL) GO TO 7100                                      00003101
      CALL NAMSET (NMCELL,NMPROG,NMMIC,NMIC,NMICRO,1,MEMB)              00003201
C                                                                       00003301
C                        RECORDING DATA SETUP                           00003401
      IWORK(1) = MAXG                                                   00003501
      IWORK(2) = IDS                                                    00003601
      IWORK(3) = IPL                                                    00003701
      IWORK(4) = MAXM                                                   00003801
      IWORK(5) = MAXI                                                   00003901
      IWORK(6) = NMIC                                                   00004001
      IWORK(7) = NUCN                                                   00004101
      CALL DATE (IWORK(8))                                              00004201
      DO 10 I=1,18                                                      00004301
      IWORK(I+9) = ITITLE(I)                                            00004401
   10 CONTINUE                                                          00004501
      IF(NMIC.LE.0)  GO TO 30                                           00004601
      DO 20 I=1,NMIC                                                    00004701
      IWORK(I+27) = NMICRO(I)                                           00004801
   20 CONTINUE                                                          00004901
   30 CONTINUE                                                          00005001
      NW = 27 + NMIC                                                    00005101
      IF (NUCN.LE.0) GO TO 60                                           00005201
      DO 40 I=1,NUCN                                                    00005301
      IWORK(I+NW) = NMNUC(I)                                            00005401
   40 CONTINUE                                                          00005501
      NW = NW+NUCN                                                      00005601
      DO 50 I=1,NUCN                                                    00005701
      WORK(I+NW) = DENHOM(I)                                            00005801
   50 CONTINUE                                                          00005901
      NW = NW+NUCN                                                      00006001
   60 CONTINUE                                                          00006101
      CALL PDSPUT (NMPDS,MEMB,IWORK,NW)                                 00006201
      GO TO 9999                                                        00006301
C                                                                       00006401
      ENTRY GETID (NMPDS,NMCELL,NMPROG,ITITLE,MAXG,IDS,IPL,MAXM,        00006501
     +                  MAXI,NMIC,NMICRO,NUCN,NMNUC,DENHOM,IDATE)       00006601
C                                                                       00006701
C      READ ID DATA FROM PDS FILE                                       00006801
      NMIC = 1                                                          00006901
      CALL NAMSET (NMCELL,NMPROG,NMMIC,NMIC,NMICRO,1,MEMB)              00007001
      CALL PDSLEN (NMPDS,MEMB,LENG)                                     00007101
      IF (LENG.LT.0) GO TO 7000                                         00007201
      IF (LENG.GT.MAXL) GO TO 7100                                      00007301
      CALL PDSGET (NMPDS,MEMB,IWORK,LENG)                               00007401
      MAXG = IWORK(1)                                                   00007501
      IDS = IWORK(2)                                                    00007601
      IPL = IWORK(3)                                                    00007701
      MAXM = IWORK(4)                                                   00007801
      MAXI = IWORK(5)                                                   00007901
      NMIC = IWORK(6)                                                   00008001
      NMICW= IWORK(6)                                                   00008101
      NUCN = IWORK(7)                                                   00008201
      NUCNW = IWORK(7)                                                  00008301
      IDATE(1) = IWORK(8)                                               00008401
      IDATE(2) = IWORK(9)                                               00008501
      DO 70 I=1,18                                                      00008601
      ITITLE(I) = IWORK(I+9)                                            00008701
   70 CONTINUE                                                          00008801
      IF (NMICW.LE.0) GO TO 90                                          00008901
      DO 80 I=1,NMICW                                                   00009001
      NMICRO(I) = IWORK(I+27)                                           00009101
   80 CONTINUE                                                          00009201
   90 CONTINUE                                                          00009301
      IF (NUCNW.LE.0) GO TO 120                                         00009401
      NW = 27+NMICW                                                     00009501
      DO 100 I=1,NUCNW                                                  00009601
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      NMNUC(I) = IWORK(I+NW)                                                    00009701
  100 CONTINUE                                                                  00009801
      NW = NW+NUCNW                                                             00009901
      DO 110 I=1,NUCNW                                                          00010001
      DENHOM(I) = WORK(I+NW)                                                    00010101
  110 CONTINUE                                                                  00010201
  120 CONTINUE                                                                  00010301
      GO TO 9999                                                                00010401
C                                                                               00010501
 7000 CONTINUE                                                                  00010601
      WRITE (6,7010) MEMB                                                       00010701
 7010 FORMAT ('0***** ERROR    MEMBER NAME ''',2A4,''' DOES NOT EXIST')        00010801
      STOP 100                                                                  00010901
C                                                                               00011001
 7100 CONTINUE                                                                  00011101
      WRITE (6,65) MAXL,LENG                                                    00011201
   65 FORMAT ('0***** ERROR AREA SIZE IS TOO SMALL *****',                      00011301
     1       /,' ',T20,'RESERVED AREA IS ',I5,' WORDS',                         00011401
     2       /,' ',T20,'REQUIRED AREA IS ',I5,' WORDS')                         00011501
      STOP 110                                                                  00011601
C                                                                               00011701
 9999 CONTINUE                                                                  00011801
      RETURN                                                                    00011901
      END                                                                       00012001
      SUBROUTINE NAMSET (NMCELL,NMPROG,MICCOD,NMIC,NMICRO,KACC,MEMB)            00010000
C                                                                               00020000
C       THIS SUBROUTINE SETS MEMBER NAME OF PDS FILE                            00030000
C                                                                               00040000
C --- 83/08/11 --- ADDITION OF KACC=6 OPTION FOR ZONE AVERAGED FLUX             00050000
C --- 83/08/11 --- BY T.MITSUNARI JAIS                                          00060000
C                                                                               00070000
C     ARGUMENT LIST                                                             00080000
C        NMCELL ---- REGION NAME (6 CHARACTOR)                                  00090000
C        NMPROG ---- PROCESSED PROGRAM NAME (4 CHARACTOR)                       00100000
C        MICCOD ---- NUCLEAR CODE NAME (CHARACTOR OR INTEGER)                   00110000
C        NMIC ------ NO. OF NUCLEAR WHICH IS OUTPUTED TO PDS FILE               00120000
C        NMICRO ---- NUCLEAR CODE NAME TABLE                                    00130000
C        KACC ------ ACCESS CEDE    = 1 ; ID                                    00140000
C                                   = 2 ; MACROSCOPIC CROSS SECTION             00150000
C                                   = 3 ; MICROSCOPIC CROSS SECTION             00160000
C                                   = 4 ; BUCKLING                              00170000
C                                   = 5 ; FISSION SPECTRUM                      00180000
C                                   = 6 ; ZONE AVERAGED FLUX                    00190000
C        MEMB ------ MEMBER NAME OF PDS FILE                                    00200000
C                                                                               00210000
      DIMENSION NMCELL(2),NMICRO(NMIC)                                          00220000
C*-----< 1 LINE UPDATE (93/05/17)                                               00230001
C*    CHARACTER*4 MEMB(2)                                                       00240001
      CHARACTER*4 MEMB(2), NUM                                                  00250001
C*-----< 2 LINES INSERT  (93/05/17)                                             00260001
      INTEGER*4  SPACE                                                          00270001
      DATA    SPACE  / '    ' /                                                 00280001
C                                                                               00290000
      INTEGER KODE(10,2)                                                        00300000
     1    / 'ESEL','TIMS','SLAR','PIGE','EXPA','ANIS','CITA',3*'    ',         00310000
     2      'E   ','T   ','S   ','P   ','G   ','A   ','C   ',3*'    '/         00320000
      DATA  IDCOD, KBUCK, MACRO, KHI  , LUXF                                    00330000
C*-----< 1 LINE UPDATE (93/05/17)                                               00340001
C*   +    /'0   ','@   ','$   ','#   ','Z   '/                                00350001
     +    /'00  ','@@  ','$$  ','##  ','ZZ  '/                                00360001
C*-----< 6 LINES OMIT  (93/05/17)                                               00370001
C+    INTEGER MICKOD(34)                                                        00380001
C+   1 /'1   ','2   ','3   ','4   ','5   ','6   ','7   ','8   ',               00390001
C+   2  '9   ','A   ','B   ','C   ','D   ','E   ','F   ','G   ',               00400001
C+   3  'H   ','I   ','J   ','K   ','L   ','M   ','N   ','O   ',               00410001
C+   4  'P   ','Q   ','R   ','S   ','T   ','U   ','V   ','W   ',               00420001
C+   5  'X   ','Y   '/                                                         00430001
C                                                                               00440000
C                                                                               00450000
      IF (KACC.LT.1 .OR. KACC.GT.6) GO TO 7000                                  00460000
C                                                                               00470000
      GO TO (1100,1200,1300,1400,1500,1600) ,KACC                               00480000
C                                                                               00490000
C                          MEMBER NAME FOR ID DATA                              00500000
 1100 CONTINUE                                                                  00510000
      ID = IDCOD                                                                00520000
      GO TO 2000                                                                00530000
C                             MEMBER NAME FOR MACRO DATA                        00540000
 1200 CONTINUE                                                                  00550000
      ID = MACRO                                                                00560000
      GO TO 2000                                                                00570000
C                             MEMBER NAME FOR MICRO DATA                        00580000
 1300 CONTINUE                                                                  00590000
      IF (NMIC .LE. 0 ) GO TO 7100                                              00600000
C*-----< 1 LINE OMIT   (93/05/17)                                               00610001
C*    ID = MICKOD(1)                                                            00620001
      DO 1310 I=1,NMIC                                                          00630000
      IF (MICCOD.NE.NMICRO(I)) GO TO 1310                                       00640000
C*-----< 1 LINE OMIT & 2 LINES INSERT  (93/05/17)                               00650001
C+    ID = MICKOD(I)                                                            00660001
      WRITE(NUM,'(2X,I2)') I                                                    00670001
      IF ( NUM(3:3).EQ.' ' ) NUM(3:3) = '0'                                     00680001
      READ(NUM,'(2X,A2)') ID                                                    00690001
C*                                                                              00700001
      GO TO 1320                                                                00710000
 1310 CONTINUE                                                                  00720000
      GO TO 7100                                                                00730000
 1320 CONTINUE                                                                  00740000
      GO TO 2000                                                                00750000
C                             MEMBER NAME FOR BUCKLING DATA                     00760000
 1400 CONTINUE                                                                  00770000
      ID = KBUCK                                                                00780000
      GO TO 2000                                                                00790000
C                             MEMBER NAME FOR FISSION SPECTRUM DATA             00800000
 1500 CONTINUE                                                                  00810000
      ID = KHI                                                                  00820000
      GO TO 2000                                                                00830000
C                             MEMBER NAME FOR ZONE AVERAGED FLUX DATA           00840000
 1600 CONTINUE                                                                  00850000
      ID = LUXF                                                                 00860000
C                                                                               00870000
 2000 CONTINUE                                                                  00880000
C                                                                               00890000
      ID1 = 10                                                                  00900000
      DO 100 I=1,10                                                             00910000
      IF ( KODE(I,1).NE.NMPROG ) GO TO 100                                      00920000
      ID1 = I                                                                   00930000
      GO TO 200                                                                 00940000
```

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  100 CONTINUE                                                          00950000
C                                                                       00960000
  200 CONTINUE                                                          00970000
C*    MEMB(1) = NMCELL(1)                                               00980000
C*    ENCODE (4,4000,MEMB(2)) NMCELL(2),KODE(ID1,2),ID                  00990000
      WRITE(MEMB(1),'(A4)') NMCELL(1)                                   01000000
      WRITE(MEMB(2),4000) NMCELL(2),KODE(ID1,2),ID                      01010000
      CALL NMCHEC (MEMB)                                                01020000
C*-----< 1 LINE UPDATE   (93/05/17)                                     01030001
C4000 FORMAT (A2,2A1)                                                   01040001
 4000 FORMAT (2A1,A2)                                                   01050001
C                                                                       01060000
      GO TO 9999                                                        01070000
C                                                                       01080000
C                              ERROR MESSAGE                            01090000
 7000 CONTINUE                                                          01100000
      WRITE (6,7010)                                                    01110000
 7010 FORMAT ('0***** ERROR IN NAMSET  ACCESS CODE IS OUT OF RANGE')    01120000
      GO TO 9999                                                        01130000
C                                                                       01140000
 7100 CONTINUE                                                          01150000
      WRITE (6,7110) MICCOD                                             01160000
 7110 FORMAT ('0*** ERROR IN NAMSET SPECIFIED NUCLIDE IS NOT EXIST ',I5)01170000
C                                                                       01180000
 9999 CONTINUE                                                          01190000
      RETURN                                                            01200000
      END                                                               01210000
//LKED.OLDLM DD DSN=POC0H##.PROGSET.LOAD,DISP=SHR,LABEL=(,,,IN)         00133029
//LKED.SYSIN DD *                                                       00134028
   INCLUDE OLDLM(PDSDUMP)                                               00135029
   ENTRY MAIN                                                           00136028
   NAME  MAIN(R)                                                        00137028
/*                                                                      00138028
//*------+---------+---------+---------+---------+---------+          00000090
//GO.FT06F001 DD SYSOUT=*                                               00000070
//*------+---------+---------+---------+---------+---------+          00000090
//* PRINT OPTION EXPLANATION                                            00000090
//* 1 --- INDEX INFORMATION                                             00000090
//* 2 --- MACRO CROSS SECTION                                           00000090
//* 3 --- MICRO CROSS SECTION                                           00000090
//* 4 --- BUCKLING                                                      00000090
//* 5 --- FISSION SPECTRUM                                              00000090
//* 6 --- NEUTRON FLUX                                                  00000090
//*------+---------+---------+---------+---------+---------+          00000090
//GO.USERPDS  DD DSN=POC0B17.@GDI1P18.PDSMICN,LABEL=(,,,IN),DISP=SHR    00000060
//GO.SYSIN  DD *                                                        00000100
INCOR             /* MEMBER NAME IN PDS FILE
SLAROM            /* PROCESSED PROGRAME NAME                           00000520
5                 /* PRINT OPTION (FISSION SPECTRUM)                   00000520
OTCOR             /* MEMBER NAME IN PDS FILE
SLAROM            /* PROCESSED PROGRAME NAME                           00000520
5                 /* PRINT OPTION (MACRO CROSS SECTION)                00000520
/*                /* CAN REPEAT SAME PROCESS
//
```


JCL file [19] .OPJCL.CNTL(GDI1MY)

MOSES snapshot, 'rod worth'

```
//POC0B17T JOB (),MOSESV1,NOTIFY=POC0B17,
//    MSGCLASS=X,MSGLEVEL=(1,1),CLASS=4,TIME=0030
//*
//MOSESV1 PROC MODULE=C701K,OUT='*',STEPDS='MOSES15M.LOAD',
// NX=60,NS=1015,N1=100,
// N4=1,N7=103,N8=103,N9=933,N10=933,N11=1015
//GO      EXEC  PGM=&MODULE,PARM='FLIB(RUN77)'
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB DD DISP=SHR,DSN=POC3A12.&STEPDS
//PRINT    DD SYSOUT=&OUT,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330)
//FT06F001 DD SYSOUT=&OUT,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330)
//*FT06F001 DD DSN=POC3AA7.MRI.MOSESV1.L6(SHUFFLTA),DISP=SHR,
//*            LABEL=(,,,IN)
//FT07F001 DD DUMMY
//FT08F001 DD DUMMY
//*FT08F001 DD DSN=POC3AA7.MRI.MOSESV1.CNTL(DEBUGTB),DISP=SHR,
//*            LABEL=(,,,IN)
//FT69F001 DD DUMMY
//*FT69F001 DD DSN=POC3AA7.MRI.MOSESV1.L69(SHUFFLT1),DISP=SHR,
//*            LABEL=(,,,IN)
//FT09F001 DD SYSOUT=&OUT,DCB=*.FT06F001
//FT90F001 DD DUMMY
//FT99F001 DD SYSOUT=&OUT,DCB=*.FT06F001
//*
//FT47F001 DD DSN=&AEXPO,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=(RECFM=VBS,LRECL=X,BLKSIZE=2000,BUFNO=2)
//FT41F001 DD DSN=&AEXPR,UNIT=SYSDA,SPACE=(TRK,(100,50)),DISP=(,PASS),
//            DCB=*.FT47F001
//FT49F001 DD DSN=&AEXPR,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=*.FT47F001
//FT48F001 DD DSN=&A6EXP,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=*.FT47F001
//FT72F001 DD DSN=&AEXPR,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=*.FT47F001
//FT73F001 DD DSN=&A6EXR,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=*.FT47F001
//*
//FT12F001 DD DSN=&WKFIL,UNIT=SYSDA,SPACE=(TRK,(5,5)),DISP=(,PASS),
//            DCB=(RECFM=VBS,LRECL=X,BLKSIZE=32760,BUFNO=1)
//*           DCB=(RECFM=VBS,LRECL=32756,BLKSIZE=32760,BUFNO=1)
//*           DCB=(RECFM=VBS,LRECL=13026,BLKSIZE=13030,BUFNO=1)
//FT13F001 DD DSN=&WKFLO,UNIT=SYSDA,SPACE=(TRK,(5,5)),DISP=(,PASS),
//            DCB=*.FT12F001
//*
//FT20F001 DD DSN=&LOADI,UNIT=SYSDA,SPACE=(TRK,(5,5)),DISP=(,PASS),
//            DCB=*.FT12F001
//*
//FT10F001 DD DSN=&INO66,UNIT=SYSDA,SPACE=(TRK,(40,30)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT11F001 DD DSN=&INO61,UNIT=SYSDA,SPACE=(TRK,(40,30)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT25F001 DD DSN=&IDEPI,UNIT=SYSDA,SPACE=(TRK,(15,15)),DISP=(,PASS),
//            DCB=*.FT12F001
```

```
//FT26F001 DD DSN=&KEFFC,UNIT=SYSDA,SPACE=(TRK,(10,10)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT27F001 DD DSN=&RPEAK,UNIT=SYSDA,SPACE=(TRK,(15,15)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT28F001 DD DSN=&POFLU,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT31F001 DD DSN=&AJFLU,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT32F001 DD DSN=&FTFLY,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT39F001 DD DSN=&P13PO,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT40F001 DD DSN=&P6FLU,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT42F001 DD DSN=&DLEAK,UNIT=SYSDA,SPACE=(TRK,(10,10)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT44F001 DD DSN=&AFLUX,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT45F001 DD DSN=&APOWR,UNIT=SYSDA,SPACE=(TRK,(15,15)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT46F001 DD DSN=&P6POW,UNIT=SYSDA,SPACE=(TRK,(100,25)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT50F001 DD DSN=&AVTEM,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT54F001 DD DSN=&TDEPN,UNIT=SYSDA,SPACE=(TRK,(15,15)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT55F001 DD DSN=&FLUX,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT56F001 DD DSN=&FTAU,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT57F001 DD DSN=&SOURC,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT58F001 DD DSN=&PTSAE,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT59F001 DD DSN=&DLEK1,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT60F001 DD DSN=&FTFLX,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT61F001 DD DSN=&P6HTX,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT16F001 DD DSN=&HIST1,UNIT=SYSDA,SPACE=(TRK,(5,5)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT17F001 DD DSN=&HIST2,UNIT=SYSDA,SPACE=(TRK,(5,5)),DISP=(,PASS),
//            DCB=*.FT12F001
//PLOTLOG DD DUMMY
//GDFILE  DD DUMMY
//*PLOTLOG DD SYSOUT=&OUT,DCB=*.FT06F001
//*GDFILE  DD SYSOUT=&OUT,DCB=*.FT06F001
//*PLOTPRM DD *
//* SCALE=0.7
//*--------------------------------------------------------------------
//FT01F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,2)),DCB=*.FT12F001
//FT02F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(&N4)),DCB=*.FT01F001
//FT15F001 DD UNIT=SYSDA,SPACE=(TRK,(&N7)),DCB=*.FT01F001
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(&N8)),DCB=*.FT15F001
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT19F001 DD UNIT=SYSDA,SPACE=(TRK,(&N9)),DCB=*.FT01F001
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(&N10)),DCB=*.FT01F001
```



```
//FT34F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT35F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,2)),DCB=*.FT01F001
//FT36F001 DD UNIT=SYSDA,SPACE=(TRK,(&N11)),DCB=*.FT01F001
//FT37F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,2)),DCB=*.FT01F001
//FT38F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT43F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT51F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT52F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,2)),DCB=*.FT01F001
//FT62F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT63F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//*--- INTERFACE FILE
//FT74F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT76F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT77F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT79F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT82F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//            PEND
//*
//   EXEC MOSESV1,
// N1=100,N2=6526,N3=10,N4=1,N5=2877,N6=10,
// N7=103,N8=103,N9=933,N10=933,N11=1015,N12=1,N13=1,N14=1,
// N15=10,N16=6526,NX=60,NS=1015
//PLOTLOG DD DUMMY
//GDFILE   DD SYSOUT=R
//PLOTPRM  DD *
 SCALE=0.7
/*
//FT03F001 DD DISP=SHR,DSN=POC0B17.OBHZHBC7.MIC7GJ3,LABEL=(,,,IN)
//FT05F001 DD DISP=SHR,LABEL=(,,,IN),
//            DSN=POC0B17.OPMOSD.DATA(GDI1DY)
//
```

JCL file [20] .OPJCL.CNTL(GDI1XSLA)

SLAROM, 'shutdown margin'

```
//POC0B17X JOB (),'PTSLAROM',MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),  00010042
// CLASS=B,TIME=0005                                                    00020001
//*******************************                                      00030000
//***        SLAROM          ***  FOR PERTURBATION, INC.DOPP.-DENSITY   00040029
//*******************************                                      00050000
//DATAP   EXEC PGM=DATAP                                               00060032
//STEPLIB  DD DSN=POC0H##.DATAP.LOAD,DISP=SHR,LABEL=(,,,IN)            00070032
//FT06F001 DD SYSOUT=*                                                 00080014
//*               ++++++++++++++++++++++++++  INPUT SLAROM N.D.(FUEL*3) 00110021
//FT05F001 DD DSN=POC0B17.OPDEND.DATA(GDI1RZEC),DISP=SHR,              00120045
//*            ---------------------------                             00121002
//            LABEL=(,,,IN)                                            00130000
//FT09F001 DD UNIT=SYSDA,DSN=&&INPUT,DISP=(,PASS),SPACE=(CYL,(1,1))    00131014
//*********************************************************************00140000
//GO      EXEC PGM=SLAROM                                              00160033
//STEPLIB  DD DSN=POC0EA1.SLAROM.NEDAC.LOAD,DISP=SHR                   00180033
//*------( INPUT PDS  )-------------------------------------------------00190000
```

```
//PDSIN    DD DUMMY                                                    00200000
//*              ++++++++++++++++++++++       OUTPUT 70 GROUP PDS    00210021
//PDSOUT   DD DSN=POC0B17.@GDI1P.PDS70G,DISP=SHR                       00220046
//*              ----------------------                                00221021
//*           DISP=(NEW,CATLG),UNIT=DASD,                              00230046
//*           DCB=(RECFM=FB,BLKSIZE=4000,LRECL=4,DSORG=PO),            00240046
//*           SPACE=(CYL,(10,20,50),RLSE)                              00250046
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),                           00270000
//           DCB=(RECFM=VSB,LRECL=32756,BLKSIZE=32760)                 00280015
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00290000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001             00300000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00310000
//FT05F001 DD DDNAME=SYSIN                                             00330014
//FT06F001 DD SYSOUT=*,DCB=(RECFM=FB,LRECL=137,BLKSIZE=1370)           00350014
//FT06F002 DD SYSOUT=*,DCB=(RECFM=FB,LRECL=137,BLKSIZE=1370)           00371014
//FT07F001 DD DUMMY                                                    00380000
//*              ++++++++++++++++++++       INPUT REF. 70 GROUP MICRO00390002
//FT08F001 DD DSN=POC0H##.JFS3J3.Y9406,DISP=SHR,LABEL=(,,,IN)          00420010
//*              ----------------------                                00430002
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(10,10)),DCB=*.FT01F001            00440014
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001             00450000
//FT11F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00460000
//FT12F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00470000
//FT13F001 DD DUMMY                                                    00471014
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(10,5)),DCB=*.FT01F001             00480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00500000
//FT22F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00510000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00520000
//FT26F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00530000
//FT30F001 DD DUMMY                                                    00540000
//FT40F001 DD SYSOUT=*                                                 00550000
//FT41F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00560000
//FT42F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00570000
//FT43F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00580000
//FT55F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00590000
//FT56F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00600000
//FT59F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00610000
//FT60F001 DD SYSOUT=*                                                 00620014
//FT70F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00630000
//FT72F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00640000
//FT73F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00650000
//FT71F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00660000
//FT80F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00670000
//FT90F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00680000
//FT96F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00690000
//FT99F001 DD UNIT=SYSDA,SPACE=(CYL,(5,5)),DCB=*.FT01F001              00700000
//SYSIN    DD DSN=&&INPUT,DISP=(OLD,DELETE)                            00730015
//                                                                     02410000
```


JCL file [21] .OPJCL.CNTL(GDI1X70N)

CITATION, normal, 70 groups, 'shutdown margin'

```
//POC0B17X JOB (),'NEMC7GOR',MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),  00010042
// CLASS=B,TIME=0005                                                    00020001
//*********************************************************************//00770000
//*     JOINT ---> CITATION                                           */00790000
//*********************************************************************//00810000
//JOINT1  EXEC PGM=JOINTX                                              00950032
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR                          00960032
//SYSPRINT DD SYSOUT=*                                                 00970000
//*              ++++++++++++++++++++++++++++    INPUT 70GP. MIC&MAC.  00971015
//USERPDS  DD DSN=POC0B17.@GDI1P.PDS70G,DISP=SHR                       00980044
//*              ----------------------------                          00981015
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,10)),                          00991031
//            DISP=(,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1) 01000031
//*              ++++++++++++++++++++++++++++  INPUT CIT.DATA 70GP/D&A  01010019
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PFC3N70X),DISP=SHR,              01011038
//*              ----------------------------                          01012002
//            LABEL=(,,,IN)                                            01020000
//FT06F001 DD SYSOUT=*                                                 01030031
//*FT06F001 DD DSN=&&LIST4,DISP=(NEW,PASS),                           01031031
//*            SPACE=(CYL,(10,3)),                                     01040031
//*            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK        01050031
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01060000
//            SPACE=(TRK,(10,10)),                                     01070000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                     01080000
//FT09F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01090000
//            SPACE=(TRK,(10,10))                                      01100000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01110000
//            SPACE=(TRK,(10,10)),                                     01120000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                     01130000
//FT20F001 DD DUMMY                                                    01140000
//FT50F001 DD SYSOUT=*                                                 01150000
//*                                                                    01160000
//*LOUT4    EXEC COMPACT,PARM='TYPE2,CC=NO'                            01170031
//*UTYIN    DD DSN=&&LIST4,DISP=(OLD,DELETE)                           01180031
//*-----------------(  CITATION  )-------------------------------------01190000
//CITATION EXEC PGM=CITATION,COND=(4,LT)                               01200000
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR                         01210000
//SYSPRINT DD SYSOUT=*                                                 01220000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                           01230000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                  01240000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01250000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01260000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01270000
//FT05F001 DD DSN=*.JOINT1.FT08F001,DISP=(OLD,DELETE)                  01280000
//FT06F001 DD SYSOUT=*                                                 01290000
//*---( OUTPUT  ZONE AVERAGED FLUX & AXIAL BUCKLING )------------***    01300000
//FT07F001 DD DSN=&&CIT,DISP=(NEW,PASS),UNIT=WORK,                     01310000
//            SPACE=(TRK,(2,1),RLSE),                                  01320000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)                     01330000
//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                           01340000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                  01350000
//*---( OUTPUT  FLUX MAP )-----------------------------------------**   01360000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001              01370000
```

```
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01380000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01390000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01400000
//*---( RESTART FILE )-------------------------------------------**      01410000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01420000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01430000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(2,5)),DCB=*.FT01F001                01440000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01450000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01460000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001               01470000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                01480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01500000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01510000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01520000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01530000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01540000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01550000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01560000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01570000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01580000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001                01590000
//*---( MACRO CROSS SECTIONS )-----------------------------------------01600000
//FT31F001 DD DSN=*.JOINT1.FT09F001,DISP=(OLD,DELETE)                    01610000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01620000
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001              01630000
//*              ++++++++++++++++++++++++  OUTPUT 70 GP FLUX DIR&ADJ.    01640019
//FT34F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001                01650026
//*FT34F001 DD DSN=POC0B17.@LCM4P.FT34G70N,DISP=(NEW,CATLG),             01650126
//*              ----------------------                                  01651019
//*            UNIT=DASD,SPACE=(TRK,(5,5),RLSE),DCB=*.FT01F001           01652030
//FT51F001 DD SYSOUT=*                                                   01660031
//*FT51F001 DD DSN=&&LIST5,DISP=(NEW,PASS),                              01661031
//*            SPACE=(CYL,(10,3)),                                       01670031
//*            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK          01680031
//*                                                                      01690000
//*LOUT5    EXEC COMPACT,PARM='TYPE2,CC=YES'                            01700031
//*UTYIN    DD DSN=&&LIST5,DISP=(OLD,DELETE)                            01710031
//*------------------(  JOINT.MIC  )-------------------------------------01720000
//JOINT2   EXEC PGM=JOINTX                                               01750032
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)              01760033
//SYSPRINT DD SYSOUT=*                                                   01770000
//*              ++++++++++++++++++++                OUTPUT 70 GROUP FLUX01780002
//USERPDS  DD DSN=POC0B17.@GDI1P70.FLUXN,DISP=(NEW,CATLG),UNIT=DASD,     01781044
//*              --------------------                                    01782002
//        DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),                           01790000
//        SPACE=(TRK,(5,1,3),RLSE)                                       01800000
//FT01F001 DD DSN=&&CIT,DISP=(OLD,DELETE)                                01810000
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                              01820000
//*              ++++++++++++++++++++++++++     INPUT FLUX EDIT CONTROL01830002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PFC3FX),DISP=SHR                   01831038
//*              --------------------------                              01832002
//FT06F001 DD SYSOUT=*                                                   01840000
//FT90S001 DD SYSOUT=*                                                   01850000
//*--------------------(  JOINT.MIC  )-------------------------------------01870000
//JOINT3   EXEC PGM=JOINTX                                               01900032
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)              01910032
//SYSPRINT DD SYSOUT=*                                                   01920000
//*              ++++++++++++++++++++     INPUT 70GP. PDS (MIC&MAC)     01921015
```

```
//PDSIN    DD DSN=POC0B17.@GDI1P.PDS70G,DISP=SHR                         01930044
//*              ----------------------                                  01931015
//*              ++++++++++++++++++++++          OUTPUT 18GP. PDS MIC&MAC01940018
//PDSOUT   DD DSN=POC0B17.@GDI1P18.PDSMICN,                              01960044
//*              ----------------------                                  01961002
//      UNIT=DASD,DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),DISP=(NEW,CATLG),  01970000
//      SPACE=(TRK,(7,1,30))                                             01980021
//*              ++++++++++++++++++++                OUTPUT 70 GROUP FLUX01990002
//USERPDS  DD DSN=POC0B17.@GDI1P70.FLUXN,DISP=SHR                        02000044
//*              ----------------------                                  02001002
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                              02010000
//*              ++++++++++++++++++++++++++  INPUT CONDENSATION CONTROL02020002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PFC3C18X),DISP=SHR,                02021038
//*              ---------------------------                             02022002
//         LABEL=(,,,IN)                                                 02030000
//FT06F001 DD SYSOUT=*                                                   02040000
//FT90S001 DD SYSOUT=*                                                   02050000
//*-----------------(  JOINT  )-----------------------------------------02060025
//MICRO   EXEC PGM=JOINTX                                                02070032
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)              02080032
//SYSPRINT DD SYSOUT=*,                                                  02090025
//         DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)                       02100025
//*              ++++++++++++++++++++++          OUTPUT 7 GP. MICRO (PDS)02110025
//USERPDS  DD DSN=POC0B17.@GDI1P18.PDSMICN,DISP=SHR                      02120044
//*              ----------------------                                  02130025
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2)),                             02140025
//         DISP=(,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1)     02150025
//*              ++++++++++++++++++++++++++     INPUT MICRO EDIT CONTROL02160025
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PFC3MX),DISP=SHR                   02170038
//*              ---------------------------                             02180025
//FT06F001 DD SYSOUT=*                                                   02190031
//*FT06F001 DD DSN=&&LIST6,DISP=(NEW,PASS),                              02191031
//*             SPACE=(CYL,(10,3)),                                      02200031
//*             DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK         02210031
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                         02220025
//         SPACE=(TRK,(10,10)),                                          02230025
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                          02240025
//*              ++++++++++++++++++          OUTPUT 7 GP. MICRO (SLAROM)02250025
//FT09F001 DD DSN=POC0B17.@GDI1P18.MICRON,DISP=(NEW,CATLG),UNIT=SYSDA,   02260044
//*              ------------------                                      02270025
//         SPACE=(TRK,(10,5),RLSE),                                      02280025
//         DCB=(RECFM=VBS,LRECL=X,BLKSIZE=26793)                         02290025
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                         02300025
//         SPACE=(TRK,(10,10)),                                          02310025
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                          02320025
//FT20F001 DD DUMMY                                                      02330025
//FT50F001 DD SYSOUT=*,                                                  02340025
//         DCB=(RECFM=FBA,LRECL=137,BLKSIZE=19043)                       02350025
//*                                                                      02360025
//*LOUT6    EXEC COMPACT,PARM='TYPE2,CC=NO'                              02370031
//*UTYIN  DD DSN=&&LIST6,DISP=(OLD,DELETE)                               02380031
//                                                                       02410000
```

JCL file [22] .OPJCL.CNTL(GDI1X70D)

CITATION, Doppler, 70 groups, 'shutdown margin'

```
//POC0B17X JOB (),'NEMC7GOR',MSGCLASS=X,NOTIFY=POC0B17,MSGLEVEL=(2,0),  00010039
// CLASS=B,TIME=0005                                                    00020001
//*********************************************************************//00770000
//*     JOINT ---> CITATION                                            *//00790000
//*********************************************************************//00810000
//JOINT1  EXEC PGM=JOINTX                                              00950033
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR                          00960033
//SYSPRINT DD SYSOUT=*                                                 00970000
//*               ++++++++++++++++++++++++++++    INPUT 70GP. MIC&MAC. 00971015
//USERPDS  DD DSN=POC0B17.@GDI1P.PDS70G,DISP=SHR                       00980041
//*               ----------------------------                         00981015
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,10)),                          00990000
//            DISP=(,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=1) 01000000
//*               ++++++++++++++++++++++++++++  INPUT CIT.DATA 70GP/D&A 01010019
//FT05F001 DD DSN=POC0B17.OPCITD.DATA(PFC3N70D),DISP=SHR,              01011036
//*               ----------------------------                         01012002
//            LABEL=(,,,IN)                                            01020000
//FT06F001 DD SYSOUT=*                                                 01030033
//*FT06F001 DD DSN=&&LIST4,DISP=(NEW,PASS),                           01031033
//*            SPACE=(CYL,(10,3)),                                     01040033
//*            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK        01050033
//FT08F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01060000
//            SPACE=(TRK,(10,10)),                                     01070000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                     01080000
//FT09F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01090000
//            SPACE=(TRK,(10,10))                                      01100000
//FT10F001 DD DISP=(NEW,PASS,DELETE),UNIT=SYSDA,                       01110000
//            SPACE=(TRK,(10,10)),                                     01120000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)                     01130000
//FT20F001 DD DUMMY                                                    01140000
//FT50F001 DD SYSOUT=*                                                 01150000
//*                                                                    01160000
//*LOUT4    EXEC COMPACT,PARM='TYPE2,CC=NO'                            01170033
//*UTYIN    DD DSN=&&LIST4,DISP=(OLD,DELETE)                           01180033
//*-----------------(  CITATION  )-------------------------------------01190000
//CITATION EXEC PGM=CITATION,COND=(4,LT)                               01200000
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR                         01210000
//SYSPRINT DD SYSOUT=*                                                 01220000
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                           01230000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                  01240000
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01250000
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01260000
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01270000
//FT05F001 DD DSN=*.JOINT1.FT08F001,DISP=(OLD,DELETE)                  01280000
//FT06F001 DD SYSOUT=*                                                 01290000
//*---( OUTPUT  ZONE AVERAGED FLUX & AXIAL BUCKLING )------------***    01300000
//FT07F001 DD DSN=&&CIT,DISP=(NEW,PASS),UNIT=WORK,                     01310000
//            SPACE=(TRK,(2,1),RLSE),                                  01320000
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)                     01330000
//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),                           01340000
//            DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)                  01350000
//*---( OUTPUT  FLUX MAP )-------------------------------------------** 01360000
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001              01370000
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01380000
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001             01390000
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001             01400000
//*---( RESTART FILE )-----------------------------------------------** 01410000
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001             01420000
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001             01430000
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(2,5)),DCB=*.FT01F001              01440000
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001             01450000
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001             01460000
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(50,5)),DCB=*.FT01F001             01470000
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001              01480000
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01490000
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01500000
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001            01510000
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01520000
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01530000
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01540000
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001            01550000
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01560000
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001            01570000
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01580000
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001              01590000
//*---( MACRO CROSS SECTIONS )---------------------------------------- 01600000
//FT31F001 DD DSN=*.JOINT1.FT09F001,DISP=(OLD,DELETE)                  01610000
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001            01620000
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001            01630000
//*               ++++++++++++++++++++++++  OUTPUT 70 GP FLUX DIR&ADJ.  01640019
//FT34F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001              01650026
//*FT34F001 DD DSN=POC0B17.@LCM4P.FT34G70N,DISP=(NEW,CATLG),           01650126
//*               ------------------------                             01651019
//*            UNIT=DASD,SPACE=(TRK,(5,5),RLSE),DCB=*.FT01F001         01652030
//FT51F001 DD SYSOUT=*                                                 01660033
//*FT51F001 DD DSN=&&LIST5,DISP=(NEW,PASS),                           01661033
//*            SPACE=(CYL,(10,3)),                                     01670033
//*            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK        01680033
//*                                                                    01690000
//*LOUT5    EXEC COMPACT,PARM='TYPE2,CC=YES'                           01700033
//*UTYIN    DD DSN=&&LIST5,DISP=(OLD,DELETE)                           01710033
//*-----------------(  JOINT.MIC  )-----------------------------------01720000
//JOINT2   EXEC PGM=JOINTX                                             01750033
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)            01760033
//SYSPRINT DD SYSOUT=*                                                 01770000
//*               ++++++++++++++++++++                OUTPUT 70 GROUP FLUX01780002
//USERPDS  DD DSN=POC0B17.@GDI1P70.FLUXD,DISP=(NEW,CATLG),UNIT=DASD,   01781041
//*               --------------------                                 01782002
//        DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),                         01790000
//        SPACE=(TRK,(5,1,3),RLSE)                                     01800000
//FT01F001 DD DSN=&&CIT,DISP=(OLD,DELETE)                              01810000
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                            01820000
//*               ++++++++++++++++++++++++++     INPUT FLUX EDIT CONTROL01830002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PFC3FD),DISP=SHR                 01831036
//*               --------------------------                           01832002
//FT06F001 DD SYSOUT=*                                                 01840000
//FT90S001 DD SYSOUT=*                                                 01850000
//*--------------------(  JOINT.MIC  )-----------------------------------01870000
//JOINT3   EXEC PGM=JOINTX                                             01900033
//STEPLIB  DD DSN=POC0EA1.JOINT.LOAD,DISP=SHR,LABEL=(,,,IN)            01910033
//SYSPRINT DD SYSOUT=*                                                 01920000
//*               ++++++++++++++++++++++     INPUT 70GP. PDS (MIC&MAC) 01921015
```

```
//PDSIN    DD DSN=POC0B17.@GDI1P.PDS70G,DISP=SHR                          01930041
//*             ---------------------                                     01931015
//*             ++++++++++++++++++++++        OUTPUT 18GP. PDS MIC&MAC01940018
//PDSOUT   DD DSN=POC0B17.@GDI1P18.PDSMICD,                              01960041
//*             ---------------------                                     01961002
//      UNIT=DASD,DCB=(RECFM=FB,LRECL=4,BLKSIZE=4000),DISP=(NEW,CATLG),  01970000
//      SPACE=(TRK,(7,1,30))                                             01980021
//*             ++++++++++++++++++++          OUTPUT 70 GROUP FLUX01990002
//USERPDS  DD DSN=POC0B17.@GDI1P70.FLUXD,DISP=SHR                        02000041
//*             --------------------                                      02001002
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(10,2))                              02010000
//*             ++++++++++++++++++++++++++  INPUT CONDENSATION CONTROL02020002
//FT05F001 DD DSN=POC0B17.OPEDID.DATA(PFC3C18D),DISP=SHR,                02021037
//*             ---------------------------                               02022002
//          LABEL=(,,,IN)                                                02030000
//FT06F001 DD SYSOUT=*                                                   02040000
//FT90S001 DD SYSOUT=*                                                   02050000
//*-----------------(  JOINT  )-----------------------------------------02060025
//                                                                       02410000
```

JCL file [23] .OPJCL.CNTL(GDI1PERK)

PERKY package, 'shutdown margin'

```
//POC0B17B JOB (),'FBRJ',MSGCLASS=X,NOTIFY=POC0B17,
// MSGLEVEL=(1,1),CLASS=2,TIME=0010
//* SHORTENED , MODIFIED TO SNH FILENAMES
//*************************************************
//** CASE PIJ1 - FINAL OPTIMIZED 165% LOQ 45.05% 4*10.5M 21/0P ZRH
//*************************************************
//************************************************* PRE-PERKY
//PREPK  EXEC PGM=PREPK99
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB  DD DSN=POC3A12.PERKYL2.CS.LOAD,DISP=SHR
//************************************************* N.D. FILE ******
//FT01F001 DD DSN=POC0B17.@GDI1.DENS,DISP=SHR
//*********************************************************************
//*                          !!
//********************************* CITATION INPUT, FOR N.D. *******
//FT02F001 DD DSN=POC0B17.@GDI1.CITDAT,DISP=SHR,LABEL=(,,,IN)
//*********************************************************************
//*
//FT03F001 DD DSN=POC0B17.OPEDID.DATA(NAMEF#XX),                    INPUT
//         DISP=SHR,LABEL=(,,,IN)                                   INPUT
//FT04F001 DD DSN=POC0B17.OPEDID.DATA(IDNUMXX),                     INPUT
//         DISP=SHR,LABEL=(,,,IN)                                   INPUT
//FT14F001 DD DSN=POC0B17.OPEDID.DATA(CHIMG),                       INPUT
//         DISP=SHR,LABEL=(,,,IN)                                   INPUT
//*
//* CYCLE  STEP  SELECT-STEP
//FT05F001 DD *                                                     INPUT
     6     2     2
/*
//*
```

```
//*   18G PDS BASE FILE (FT16F001)
//*   18G PDS BASE+500C FILE (FT17F001)
//*
//*
//****************************************** NORMAL PDS FILE ******
//FT16F001 DD DSN=POC0B17.@GDI1P18.PDSMICN,                         INPUT
//*********************************************************************
//         DISP=SHR,LABEL=(,,,IN)                                   INPUT
//****************************************** DOPPLER PDS FILE *****
//FT17F001 DD DSN=POC0B17.@GDI1P18.PDSMICD,                         INPUT
//*********************************************************************
//         DISP=SHR,LABEL=(,,,IN)                                   INPUT
//*
//*
//FT07F001 DD DSN=POC0B17.@CITE,SPACE=(TRK,(1,1)),UNIT=DASD,
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),DISP=(NEW,CATLG)
//FT21F001 DD DSN=POC0B17.@DOPE,SPACE=(TRK,(1,1)),UNIT=DASD,
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),DISP=(NEW,CATLG)
//FT22F001 DD DSN=POC0B17.@FULE,SPACE=(TRK,(1,1)),UNIT=DASD,
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),DISP=(NEW,CATLG)
//FT23F001 DD DSN=POC0B17.@STRE,SPACE=(TRK,(1,1)),UNIT=DASD,
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),DISP=(NEW,CATLG)
//FT24F001 DD DSN=POC0B17.@COLE,SPACE=(TRK,(1,1)),UNIT=DASD,
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),DISP=(NEW,CATLG)
//FT25F001 DD DSN=POC0B17.@VIDE,SPACE=(TRK,(1,1)),UNIT=DASD,
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),DISP=(NEW,CATLG)
//FT26F001 DD DSN=POC0B17.@BETE,SPACE=(TRK,(1,1)),UNIT=DASD,
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),DISP=(NEW,CATLG)
//FT27F001 DD DSN=POC0B17.@LIFE,SPACE=(TRK,(1,1)),UNIT=DASD,
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120),DISP=(NEW,CATLG)
//FT31F001 DD DSN=POC0B17.@PMICE,SPACE=(TRK,(20,20)),UNIT=DASD,
//         DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096),DISP=(NEW,CATLG)
//FT90F001 DD DUMMY
//FT06F001 DD SYSOUT=*
//*FT06F001 DD DSN=&&DALIS0,DISP=(NEW,DELETE),
//*            SPACE=(TRK,(100,50)),
//*            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK
//**
//*
//************************************************* CITATION ADJOINT
//ADJOINT  EXEC PGM=CITATION,COND=(4,LT)
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB  DD DSN=POC3A12.CITFBR.LOAD,DISP=SHR
//FT01F001 DD UNIT=SYSDA,SPACE=(CYL,(20,2)),
//         DCB=(RECFM=VSB,LRECL=4092,BLKSIZE=4096)
//FT02F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001
//FT03F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001
//FT04F001 DD UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=*.FT01F001
//*-------------------------------------------------------------------
//FT05F001 DD DSN=POC0B17.@CITE,DISP=SHR
//*-------------------------------------------------------------------
//FT06F001 DD DSN=&&DALIST,DISP=(NEW,PASS),
//            SPACE=(TRK,(30,20)),
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK
//FT07F001 DD UNIT=SYSDA,SPACE=(TRK,(50,50)),DCB=*.FT01F001
//*********************************************************************
//*_____________! CITATION 18G MICRO X-SECTION !_____________________*/
//FT08F001 DD DSN=POC0B17.@GDI1P18.MICRON,DISP=SHR,LABEL=(,,,IN)    INPUT
//*********************************************************************
```

```
//*
//FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(15,8)),DCB=*.FT01F001
//FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(4,2)),DCB=*.FT01F001
//FT11F001 DD UNIT=SYSDA,SPACE=(TRK,(100,5)),DCB=*.FT01F001
//FT12F001 DD UNIT=SYSDA,SPACE=(TRK,(100,5)),DCB=*.FT01F001
//FT13F001 DD UNIT=SYSDA,SPACE=(TRK,(100,5)),DCB=*.FT01F001
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(100,5)),DCB=*.FT01F001
//FT15F001 DD UNIT=SYSDA,SPACE=(CYL,(8,5)),DCB=*.FT01F001
//FT16F001 DD UNIT=SYSDA,SPACE=(TRK,(80,5)),DCB=*.FT01F001
//FT17F001 DD UNIT=SYSDA,SPACE=(TRK,(80,5)),DCB=*.FT01F001
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(80,5)),DCB=*.FT01F001
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(20,8)),DCB=*.FT01F001
//FT20F001 DD UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=*.FT01F001
//FT21F001 DD UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=*.FT01F001
//FT22F001 DD UNIT=SYSDA,SPACE=(TRK,(20,10)),DCB=*.FT01F001
//FT23F001 DD UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=*.FT01F001
//FT24F001 DD UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=*.FT01F001
//FT25F001 DD UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=*.FT01F001
//FT26F001 DD UNIT=SYSDA,SPACE=(TRK,(20,10)),DCB=*.FT01F001
//FT27F001 DD UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=*.FT01F001
//FT28F001 DD UNIT=SYSDA,SPACE=(TRK,(20,10)),DCB=*.FT01F001
//FT29F001 DD UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=*.FT01F001
//FT30F001 DD UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=*.FT01F001
//*-------------------------------------------------------
//FT31F001 DD DSN=POC0B17.@PMACE,UNIT=DASD,
//         DISP=(NEW,CATLG),SPACE=(TRK,(6,2),RLSE),
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
//FT34F001 DD DSN=POC0B17.@FT34E,UNIT=DASD,
//         DISP=(NEW,CATLG),SPACE=(TRK,(60,20),RLSE),
//         DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)
//*-------------------------------------------------------
//FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(10,10)),DCB=*.FT01F001
//FT33F001 DD UNIT=SYSDA,SPACE=(CYL,(8,8)),DCB=*.FT01F001
//FT51F001 DD SYSOUT=*
//FT51F001 DD DSN=&&LTCIT,DISP=(NEW,PASS),
//            SPACE=(CYL,(15,3)),
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK
//FT52F001 DD UNIT=SYSDA,SPACE=(CYL,(16,8)),DCB=*.FT01F001
//FT61F001 DD DUMMY
//FT80F001 DD DUMMY
//FT81F001 DD DUMMY
//*
//*
//************************************************** PERKY DOPPLER
//************************************************** PERKY FUEL DENS
//PERFUL   EXEC PGM=PERKY,COND=(4,LT)
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB  DD DSN=POC3A12.PERKYL2.CS.LOAD,DISP=SHR,LABEL=(,,,IN)
//SYSPRINT DD SYSOUT=*,
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=8220)
//*-------------------------------------------------------------
//FT01F001 DD DSN=POC0B17.@FT34E,DISP=SHR
//*-------------------------------------------------------------
//FT02F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DISP=(NEW,DELETE),
//         DCB=(RECFM=VBS,LRECL=23000,BLKSIZE=23004)
//FT03F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//*---------
//FT05F001 DD DSN=POC0B17.@FULE,DISP=(OLD,PASS)
//*---------
//FT06F001 DD DSN=&&FULOUT,DISP=(NEW,DELETE),
//            SPACE=(TRK,(100,10)),
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK
//FT08F001 DD DUMMY
//*MACRO1
//FT09F001 DD DUMMY
//*MACRO2
//FT10F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//*------
//FT11F001 DD DSN=POC0B17.@PMICE,DISP=SHR
//FT20F001 DD DSN=POC0B17.@PMACE,DISP=SHR
//*------
//FT13F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT14F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT15F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT16F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT18F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT19F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT21F001 DD DSN=POC0B17.DELAY.DATA,LABEL=(,,,IN),DISP=SHR
//FT22F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT25F001 DD DSN=&&PERK25,UNIT=WORK,DISP=(NEW,PASS),
//         SPACE=(TRK,(10,2),RLSE),
//         DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)
//FT27F001 DD DSN=&&PERK27,UNIT=WORK,DISP=(NEW,PASS),
//         SPACE=(TRK,(10,2),RLSE),
//         DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)
//FT31F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT32F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT41F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT42F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//*
//*
//POSFUL   EXEC PGM=POSTPK,COND=(4,LT)
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB  DD DSN=POC3A12.PERKYL2.CS.LOAD,DISP=SHR
//SYSPRINT DD SYSOUT=*,
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=8220)
//*
//* INPUT
//FT05F001 DD DSN=POC0B17.PQINT.DATA(POFUL),                    INPUT
//         DISP=SHR,LABEL=(,,,IN)                               INPUT
//*
//FT06F001 DD SYSOUT=*,
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425)
//*
//* INPUT
//FT10F001 DD DSN=POC0B17.OPEDID.DATA(ZONE#XX),                 INPUT
//         DISP=SHR,LABEL=(,,,IN)                               INPUT
//*
//FT25F001 DD DSN=&&PERK25,DISP=(OLD,DELETE)
//FT27F001 DD DSN=&&PERK27,DISP=(OLD,DELETE)
//*------
//FT34F001 DD DSN=POC0B17.@FT34E,DISP=SHR
//FT55F001 DD DSN=POC0B17.@CITE,DISP=SHR
//*------
//*
//************************************************** PERKY STRUCTURE
//PERSTR   EXEC PGM=PERKY,COND=(4,LT)
```

```
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB  DD DSN=POC3A12.PERKYL2.CS.LOAD,DISP=SHR,LABEL=(,,,IN)
//SYSPRINT DD SYSOUT=*,
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=8220)
//*-----
//FT01F001 DD DSN=POC0B17.@FT34E,DISP=SHR
//FT05F001 DD DSN=POC0B17.@STRE,DISP=SHR
//*-----
//FT02F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DISP=(NEW,DELETE),
//         DCB=(RECFM=VBS,LRECL=23000,BLKSIZE=23004)
//FT03F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT06F001 DD DSN=&&STROUT,DISP=(NEW,DELETE),
//            SPACE=(TRK,(100,20)),
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK
//FT08F001 DD DUMMY
//*MACRO1
//FT09F001 DD DUMMY
//*MACRO2
//FT10F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//*------
//FT11F001 DD DSN=POC0B17.@PMICE,DISP=SHR
//FT20F001 DD DSN=POC0B17.@PMACE,DISP=SHR
//*------
//FT13F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT14F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT15F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT16F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT18F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT19F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT21F001 DD DSN=POC0B17.DELAY.DATA,LABEL=(,,,IN),DISP=SHR
//FT22F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT25F001 DD DSN=&&PERK25,UNIT=WORK,DISP=(NEW,PASS),
//         SPACE=(TRK,(10,2),RLSE),
//         DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)
//FT27F001 DD DSN=&&PERK27,UNIT=WORK,DISP=(NEW,PASS),
//         SPACE=(TRK,(10,2),RLSE),
//         DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)
//FT31F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT32F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT41F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT42F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//*
//*
//POSSTR   EXEC PGM=POSTPK,COND=(4,LT)
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB  DD DSN=POC3A12.PERKYL2.CS.LOAD,DISP=SHR
//SYSPRINT DD SYSOUT=*,
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=8220)
//*
//* INPUT
//FT05F001 DD DSN=POC0B17.PQINT.DATA(POSTR),                    INPUT
//         DISP=SHR,LABEL=(,,,IN)                               INPUT
//*
//FT06F001 DD SYSOUT=*,
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425)
//*
//* INPUT
//FT10F001 DD DSN=POC0B17.OPEDID.DATA(ZONE#XX),                 INPUT
//         DISP=SHR,LABEL=(,,,IN)                               INPUT
//*
//FT25F001 DD DSN=&&PERK25,DISP=(OLD,DELETE)
//FT27F001 DD DSN=&&PERK27,DISP=(OLD,DELETE)
//*-----
//FT34F001 DD DSN=POC0B17.@FT34E,DISP=SHR
//FT55F001 DD DSN=POC0B17.@CITE,DISP=SHR
//*-----
//*
//*************************************************** PERKY COOLANT
//PERCOL   EXEC PGM=PERKY,COND=(4,LT)
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB  DD DSN=POC3A12.PERKYL2.CS.LOAD,DISP=SHR,LABEL=(,,,IN)
//SYSPRINT DD SYSOUT=*,
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=8220)
//*-----
//FT01F001 DD DSN=POC0B17.@FT34E,DISP=SHR
//FT05F001 DD DSN=POC0B17.@COLE,DISP=SHR
//*-----
//FT02F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DISP=(NEW,DELETE),
//         DCB=(RECFM=VBS,LRECL=23000,BLKSIZE=23004)
//FT03F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT04F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT06F001 DD DSN=&&COLOUT,DISP=(NEW,DELETE),
//            SPACE=(TRK,(100,50)),
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425),UNIT=WORK
//FT08F001 DD DUMMY
//*MACRO1
//FT09F001 DD DUMMY
//*MACRO2
//FT10F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//*-----
//FT11F001 DD DSN=POC0B17.@PMICE,DISP=(OLD,PASS)
//FT20F001 DD DSN=POC0B17.@PMACE,DISP=(OLD,PASS)
//*-----
//FT13F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT14F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT15F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT16F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT18F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT19F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT21F001 DD DSN=POC0B17.DELAY.DATA,LABEL=(,,,IN),DISP=SHR
//FT22F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT25F001 DD DSN=&&PERK25,UNIT=WORK,DISP=(NEW,PASS),
//         SPACE=(TRK,(10,2),RLSE),
//         DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)
//FT27F001 DD DSN=&&PERK27,UNIT=WORK,DISP=(NEW,PASS),
//         SPACE=(TRK,(10,2),RLSE),
//         DCB=(RECFM=VBS,LRECL=4092,BLKSIZE=4096)
//FT31F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT32F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT41F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//FT42F001 DD UNIT=WORK,SPACE=(TRK,(100,50)),DCB=*.FT02F001
//*
//*
//POSCOL   EXEC PGM=POSTPK,COND=(4,LT)
//VPSYS    DD SUBSYS=(VPCS)
//STEPLIB  DD DSN=POC3A12.PERKYL2.CS.LOAD,DISP=SHR
//SYSPRINT DD SYSOUT=*,
```

```
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=8220)
//*
//* INPUT
//FT05F001 DD DSN=POC0B17.PQINT.DATA(POCOL),                          INPUT
//         DISP=SHR,LABEL=(,,,IN)                                     INPUT
//*
//FT06F001 DD SYSOUT=*,
//            DCB=(RECFM=FBA,LRECL=137,BLKSIZE=3425)
//*
//* INPUT
//FT10F001 DD DSN=POC0B17.OPEDID.DATA(ZONE#XX),                       INPUT
//         DISP=SHR,LABEL=(,,,IN)                                     INPUT
//*
//FT25F001 DD DSN=&&PERK25,DISP=(OLD,DELETE)
//FT27F001 DD DSN=&&PERK27,DISP=(OLD,DELETE)
//*-----
//FT34F001 DD DSN=POC0B17.@FT34E,DISP=SHR
//FT55F001 DD DSN=POC0B17.@CITE,DISP=SHR
//*-----
//*
//*************************************************** PERKY VOID
//*************************************************** PERKY BETA-EFF
//*************************************************** PERKY LIFE-TIME
//*
//
```

JCL file [24] .OPJCL.CNTL(GDI1MBRN)

MOSES burn-up, '3D burn-up'

```
//POC0B17Z JOB (),MOSESV1,NOTIFY=POC0B17,
//   MSGCLASS=X,MSGLEVEL=(1,1),CLASS=4,TIME=0120
//*
//MOSESV1 PROC MODULE=MOSES96,OUT='*',STEPDS='#MOSES96.LOAD',
// NX=200,NS=5000,N1=100,
// N4=1,N7=103,N8=103,N9=933,N10=2414,N11=1015
//GO     EXEC  PGM=&MODULE,PARM='FLIB(RUN77)'
//VPSYS   DD SUBSYS=(VPCS)
//STEPLIB DD DISP=SHR,DSN=POC3A12.&STEPDS
//PRINT    DD SYSOUT=&OUT,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330)
//FT06F001 DD SYSOUT=&OUT,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330)
//*FT06F001 DD DSN=POC3AA7.MRI.MOSESV1.L6(SHUFFLTA),DISP=SHR,
//*            LABEL=(,,,IN)
//FT07F001 DD DUMMY
//FT08F001 DD DUMMY
//*FT08F001 DD DSN=POC3AA7.MRI.MOSESV1.CNTL(DEBUGTB),DISP=SHR,
//*            LABEL=(,,,IN)
//FT69F001 DD DUMMY
//*FT69F001 DD DSN=POC3AA7.MRI.MOSESV1.L69(SHUFFLT1),DISP=SHR,
//*            LABEL=(,,,IN)
//FT09F001 DD SYSOUT=&OUT,DCB=*.FT06F001
//FT90F001 DD DUMMY
//FT99F001 DD SYSOUT=&OUT,DCB=*.FT06F001
//*
//FT47F001 DD DSN=&AEXPO,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=(RECFM=VBS,LRECL=X,BLKSIZE=2000,BUFNO=2)
//FT41F001 DD DSN=&AEXPR,UNIT=SYSDA,SPACE=(TRK,(100,50)),DISP=(,PASS),
//            DCB=*.FT47F001
//FT49F001 DD DSN=&AEXPR,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=*.FT47F001
//FT48F001 DD DSN=&A6EXP,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=*.FT47F001
//FT72F001 DD DSN=&AEXPR,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=*.FT47F001
//FT73F001 DD DSN=&A6EXR,UNIT=SYSDA,SPACE=(TRK,(40,10)),DISP=(,PASS),
//            DCB=*.FT47F001
//*
//FT12F001 DD DSN=&WKFIL,UNIT=SYSDA,SPACE=(TRK,(5,5)),DISP=(,PASS),
//            DCB=(RECFM=VBS,LRECL=X,BLKSIZE=32760,BUFNO=1)
//*           DCB=(RECFM=VBS,LRECL=32756,BLKSIZE=32760,BUFNO=1)
//*           DCB=(RECFM=VBS,LRECL=13026,BLKSIZE=13030,BUFNO=1)
//FT13F001 DD DSN=&WKFLO,UNIT=SYSDA,SPACE=(TRK,(5,5)),DISP=(,PASS),
//            DCB=*.FT12F001
//*
//FT20F001 DD DSN=&LOADI,UNIT=SYSDA,SPACE=(TRK,(5,5)),DISP=(,PASS),
//            DCB=*.FT12F001
//*
//FT10F001 DD DSN=&INO66,UNIT=SYSDA,SPACE=(TRK,(40,30)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT11F001 DD DSN=&INO61,UNIT=SYSDA,SPACE=(TRK,(40,30)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT25F001 DD DSN=&IDEPI,UNIT=SYSDA,SPACE=(TRK,(15,15)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT26F001 DD DSN=&KEFFC,UNIT=SYSDA,SPACE=(TRK,(10,10)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT27F001 DD DSN=&RPEAK,UNIT=SYSDA,SPACE=(TRK,(15,15)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT28F001 DD DSN=&POFLU,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT31F001 DD DSN=&AJFLU,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT32F001 DD DSN=&FTFLY,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT39F001 DD DSN=&P13PO,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT40F001 DD DSN=&P6FLU,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT42F001 DD DSN=&DLEAK,UNIT=SYSDA,SPACE=(TRK,(10,10)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT44F001 DD DSN=&AFLUX,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT45F001 DD DSN=&APOWR,UNIT=SYSDA,SPACE=(TRK,(15,15)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT46F001 DD DSN=&P6POW,UNIT=SYSDA,SPACE=(TRK,(100,25)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT50F001 DD DSN=&AVTEM,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT54F001 DD DSN=&TDEPN,UNIT=SYSDA,SPACE=(TRK,(15,15)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT55F001 DD DSN=&FLUX,UNIT=SYSDA,SPACE=(TRK,(500,500)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT56F001 DD DSN=&FTAU,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT57F001 DD DSN=&SOURC,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
```

```
//            DCB=*.FT12F001
//FT58F001 DD DSN=&PTSAE,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT59F001 DD DSN=&DLEK1,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT60F001 DD DSN=&FTFLX,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT61F001 DD DSN=&P6HTX,UNIT=SYSDA,SPACE=(TRK,(20,20)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT16F001 DD DSN=&HIST1,UNIT=SYSDA,SPACE=(TRK,(30,30)),DISP=(,PASS),
//            DCB=*.FT12F001
//FT17F001 DD DSN=&HIST2,UNIT=SYSDA,SPACE=(TRK,(30,30)),DISP=(,PASS),
//            DCB=*.FT12F001
//PLOTLOG DD DUMMY
//GDFILE  DD DUMMY
//*PLOTLOG DD SYSOUT=&OUT,DCB=*.FT06F001
//*GDFILE  DD SYSOUT=&OUT,DCB=*.FT06F001
//*PLOTPRM DD *
//* SCALE=0.7
//*--------------------------------------------------------------------
//FT01F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,2)),DCB=*.FT12F001
//FT02F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT14F001 DD UNIT=SYSDA,SPACE=(TRK,(&N4)),DCB=*.FT01F001
//FT15F001 DD UNIT=SYSDA,SPACE=(TRK,(&N7)),DCB=*.FT01F001
//FT04F001 DD UNIT=SYSDA,SPACE=(TRK,(&N8)),DCB=*.FT15F001
//FT18F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT19F001 DD UNIT=SYSDA,SPACE=(TRK,(&N9)),DCB=*.FT01F001
//FT33F001 DD UNIT=SYSDA,SPACE=(TRK,(&N10)),DCB=*.FT01F001
//FT34F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT35F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,2)),DCB=*.FT01F001
//FT36F001 DD UNIT=SYSDA,SPACE=(TRK,(&N11)),DCB=*.FT01F001
//FT37F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,2)),DCB=*.FT01F001
//FT38F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT43F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT51F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT52F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,2)),DCB=*.FT01F001
//FT62F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//FT63F001 DD UNIT=SYSDA,SPACE=(TRK,(&NS,1)),DCB=*.FT01F001
//*--- INTERFACE FILE
//FT74F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT76F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT77F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT79F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT82F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT85F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//FT86F001 DD UNIT=SYSDA,SPACE=(TRK,(&N1,&NX)),DCB=*.FT01F001
//          PEND
//*
//   EXEC MOSESV1,
// N1=100,N2=6526,N3=10,N4=1,N5=2877,N6=10,
// N7=103,N8=103,N9=933,N10=2414,N11=1015,N12=1,N13=1,N14=1,
// N15=10,N16=6526,NX=200,NS=5000
//PLOTLOG DD DUMMY
//GDFILE   DD SYSOUT=R
//PLOTPRM  DD *
 SCALE=0.7
/*
//FT03F001 DD DISP=SHR,DSN=POC0B17.OBHZHBC7.MIC7GJ3,LABEL=(,,,IN)
//FT05F001 DD DISP=SHR,LABEL=(,,,IN),
//          DSN=POC0B17.OPMOSD.DATA(GDI1MBRN)
//
```

Example Data Files

Data file [1] .OPDEND.DATA(GDI1P)

PENCIL input, 'iterative condensation' & 'basic fuel cycle'

```
 &SET
   LAST= 1,
   PURICH= 40.2453,45.0307,
   COREH=  3.0, 6.0, 9.0, 12.0, 12.0, 9.0, 6.0, 3.0,
   ICZ=  1, 2, 3, 4, 5, 6, 7, 8,
   OCZ= 9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,
        29,30,31,32,
   NUID=  1,  2,  3,  4,  5,  6,  7,  8,  9, 10,
         11, 12, 13, 14, 15,  0,  0, 18,  0, 20,
         21, 22, 23, 24, 25, 26, 27, 28, 29,  0,
          0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
          0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
          0,  0,  0,  0,  0,  0,  0,  0,  0, 60,
          0,  0,  0,  0,  0,  0, 67, 68,  0, 70,
          0,  0,  0,  0,  0,  0,  0, 78, 79, 80,
         81,  0,  0,  0,  0,
   F=1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
   EPOWER=60.0,
   LPOWER=0.0,
   RONA=0.837936,
   DAY=296.56, 4.0, 6.0,
 &END
 INNER,CORE 7,HQPU,4*9.75M.,F165%,24P ZRH,8P B4C(30%),45%HOLE, GDI1
 &DATA
   VB4C=0.060248,
   B10W=30.0,
   DCLAD=7.422,
   HCLAD=0.5376,
   HWRAP=3.90,
   THDENS=0.687999,
   DFUEL=6.141,
   DWIRE=0.00,
   HWIRE=200.0,
   PRING=3.8040,
   NOPIN=217,
   ITYPE=0,
   PUABND=0.94,0.06,0.0,0.0,0.0,0.0,
   UABND=0.003,0.997,
   VSUS=0.6550,0.1700,0.1350,0.0250,0.0150,
   ROSUS=7.98,
   DGAP=5.8,
   SZRH=1.0,
   NZRH=24,
   ZRH=1.7,
   TRRICH=0.0,
   TRU=3*0.0,0.491,6*0.0,0.301,0.0,0.155,2*0.0,0.05,0.003,
 &END
 OUTER CORE ------------------------------------------------------------
 &DATA
   VB4C=0.060248,
   B10W=30.0,
   DCLAD=7.422,
   HCLAD=0.5376,
   HWRAP=3.90,
   THDENS=0.687999,
   DFUEL=6.141,
   DWIRE=0.00,
   HWIRE=200.0,
   PRING=3.8040,
   NOPIN=217,
   ITYPE=0,
   PUABND=0.94,0.06,0.0,0.0,0.0,0.0,
   UABND=0.003,0.997,
   VSUS=0.6550,0.1700,0.1350,0.0250,0.0150,
   ROSUS=7.98,
   DGAP=5.8,
   SZRH=1.0,
   NZRH=24,
   ZRH=1.7,
   TRRICH=0.0,
   TRU=3*0.0,0.491,6*0.0,0.301,0.0,0.155,2*0.0,0.05,0.003,
 &END
 &CONV
   CPW =1.0,
   EPW =0.002,
   CKEFF = 1.00324,
   EKEFF = 0.0005,
 &END
```

Data file [2] .OPCITD.DATA(O975M165)

CITATION input from PENCIL

```
 600MW/60CM CORE PU BURNER , OPTIMIZATION , 165% PINSIZE REFLECTORS
296.56*4 DAYS ,PENCIL DATA , CORE 7 , FULL HEIGHT & RODS , BCR&PCR 0%
001
  1  0  0  0  0  1  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  1  0  0  1  0  1  0  1  0  0  0  1  1  1  0  0  0  0  0  0  0  0  0  0
200200

002
  6  1  1  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
        296.6       1560.0
        296.6          0.0          0.0        296.6          0.0          0.0
  1  0  0  1  0  1  0  1  0  0  0  1  1  1  0  0  0  0  0  0  0  0  0
```

```
003
  0  0  0  0  7  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0
    1.0000E-4   1.0000E-5
          0.0         0.0      1560.0
004
 10 46.21720  1  4.27490  7 38.52480  1  2.29260  1  2.23650  7 38.48690
  1  4.61620  6 28.74400  1  1.24510  1  2.46280  5 21.29210  2  6.00000
  1  3.00000  4 21.10000  4 21.10000
 10 50.00000  2  7.00000  1  3.00000  2  5.00000  1  3.00000  2  6.00000
  3  9.00000  4 12.00000  4 12.00000  3  9.00000  2  6.00000  1  3.00000
  1  2.00000 14 70.00000  6 33.00000
005
 46 49 46 50 50 46 51 46 52 52 46 46 46 46 46
 41 49 41 50 50 41 51 41 52 52 41 41 41 47 46
 37 49 37 50 50 37 51 38 52 52 38 38 38 47 46
 33 49 33 50 50 33 51 34 52 52 34 34 34 47 46
  1 42  1 43 43  1 44  9 45 45  9 17 25 47 46
  2 42  2 43 43  2 44 10 45 45 10 18 26 47 46
  3 42  3 43 43  3 44 11 45 45 11 19 27 47 46
  4 42  4 43 43  4 44 12 45 45 12 20 28 47 46
  5 42  5 43 43  5 44 13 45 45 13 21 29 47 46
  6 42  6 43 43  6 44 14 45 45 14 22 30 47 46
  7 42  7 43 43  7 44 15 45 45 15 23 31 47 46
  8 42  8 43 43  8 44 16 45 45 16 24 32 47 46
 39 42 39 43 43 39 44 40 45 45 40 40 40 47 46
 35 42 35 43 43 35 44 36 45 45 36 36 36 47 46
 48 48 48 48 48 48 48 48 48 48 48 48 48 46 46
012
  1  1  4  1  0  1  0   INNER CORE1
  2  2  4  1  0  2  0   INNER CORE1
  3  3  4  1  0  3  0   INNER CORE1
  4  4  4  1  0  4  0   INNER CORE1
  5  5  4  1  0  5  0   INNER CORE1
  6  6  4  1  0  6  0   INNER CORE1
  7  7  4  1  0  7  0   INNER CORE1
  8  8  4  1  0  8  0   INNER CORE1
  9  9  4  2  0  9  0   OUTER CORE1
 10 10  4  2  0 10  0   OUTER CORE1
 11 11  4  2  0 11  0   OUTER CORE1
 12 12  4  2  0 12  0   OUTER CORE1
 13 13  4  2  0 13  0   OUTER CORE1
 14 14  4  2  0 14  0   OUTER CORE1
 15 15  4  2  0 15  0   OUTER CORE1
 16 16  4  2  0 16  0   OUTER CORE1
 17 17  4  2  0 17  0   OUTER CORE2
 18 18  4  2  0 18  0   OUTER CORE2
 19 19  4  2  0 19  0   OUTER CORE2
 20 20  4  2  0 20  0   OUTER CORE2
 21 21  4  2  0 21  0   OUTER CORE2
 22 22  4  2  0 22  0   OUTER CORE2
 23 23  4  2  0 23  0   OUTER CORE2
 24 24  4  2  0 24  0   OUTER CORE2
 25 25  4  2  0 25  0   OUTER CORE3
 26 26  4  2  0 26  0   OUTER CORE3
 27 27  4  2  0 27  0   OUTER CORE3
 28 28  4  2  0 28  0   OUTER CORE3
 29 29  4  2  0 29  0   OUTER CORE3
 30 30  4  2  0 30  0   OUTER CORE3
 31 31  4  2  0 31  0   OUTER CORE3
 32 32  4  2  0 32  0   OUTER CORE3
 33 33  0  3  0 33 -1   UPPER PLENUM INNER
 34 34  0  3  0 34 -1   UPPER PLENUM OUTER
 35 35  0  3  0 35 -1   LOWER PLENUM INNER
 36 36  0  3  0 36 -1   LOWER PLENUM OUTER
 37 37  0  4  0 37 -1   UPPER PLUG INNER
 38 38  0  4  0 38 -1   UPPER PLUG OUTER
 39 39  0  4  0 39 -1   LOWER PLUG INNER
 40 40  0  4  0 40 -1   LOWER PLUG OUTER
 41 41  0  5  0 41 -1   UPPER GAP
 42 42  0  5  0 42 -1   ROD FOLLOWER 1
 43 43  0  5  0 43 -1   ROD FOLLOWER 2
 44 44  0  5  0 44 -1   ROD FOLLOWER 3
 45 45  0  5  0 45 -1   ROD FOLLOWER 4
 46 46  0  6  0 46 -1   UPPER/OUTER SHIELD
 47 47  0  6  0 47 -1   RADIAL SHIELD INNER
 48 48  0  7  0 48 -1   LOWER SHIELD
 49 49  0  8  0 49 -1   ROD ABSORBER 1
 50 50  0  8  0 50 -1   ROD ABSORBER 2
 51 51  0  8  0 51 -1   ROD ABSORBER 3
 52 52  0  8  0 52 -1   ROD ABSORBER 4

018
  1  3  0  2  8  0  0  4  5  6  7 21 22 23 24 25 26 27 28 29 67  0 11 12
 13 14 15 18 68  0  9 10  0 78 79 80 81  0
020
 33 36  0  0
 101.03970-2 111.17900-2 123.28650-3 132.31220-3 142.61950-4 152.74470-4

 37 40  0  0
 101.03970-2 112.96650-2 128.26930-3 135.81800-3 146.59100-4 156.90610-4

 41 45  0  0
 101.99080-2 115.24170-3 121.46120-3 131.02800-3 141.16460-4 151.22020-4

 46 47  0  0
 104.38990-3 114.50900-2 121.25690-2 138.84310-3 141.00180-3 151.04970-3

 48 48  0  0
 106.36540-3 111.77540-2 124.94900-3 133.48200-3 143.94460-4 154.13320-4
 189.24600-3 677.89610-3 682.90880-2
 49 52  0  0
 109.32850-3 111.27380-2 123.55070-3 132.49820-3 142.83010-4 152.96540-4
 188.22780-3 673.04990-2 682.41210-3

034
  1  2
 31.52636-9 223.40600-6 254.92182-8

  1  2
  1  2  3  4  5  6  7  8 21 22 23 24 25 26 27 28 29
           78  0.0         0.0         0.0         0.0         0.0
 0.0           0.0         1.0         0.0         0.0         0.0
 0.0           0.0         0.0         0.0         0.0         0.0
           79  1.0         0.0         0.0         0.0         0.0
 0.0           0.0         0.0         0.0         0.0         0.0
 0.0           0.0         0.0         0.0         0.0         0.0
           80  0.0         0.0         0.0         0.0         0.0
 1.0           1.0         0.0         0.0         0.0         0.0
```

```
  0.0          0.0          0.0          0.0          0.0          0.0
           81  0.0          1.0          1.0          1.0          1.0
  0.0          0.0          0.0          1.0          1.0          1.0
  1.0          1.0          1.0          1.0          1.0          1.0


036
  1  2 11
   9    8 -22   1   2   3   4  24  27  28
  11    8 -22   1   2  -3 5052000  23 224 227 228
  11    8 -22   1   2  -3 5058000  25  26 227 228
  13    8 -22   1   2  -3 5058000 -25  29 201 202 203 204
   8    6   7  21 229 201 202 203 204
   8  508 -35 221 229 201 202 203 204
   2   78  78
   2   79  79
   2   80  80
   2   81  81
   1   67

091
     32    32     1                    1          1     2     3     4
      5     6     7     8    78    79    29    80    81
      3     5 1.52636 -09
  1  0

  2  0

  3  0

  4  0

  5  0

  6  0

  7  0

  8  0

  9  0

 10  0

 11  0

 12  0

 13  0

 14  0

 15  0

 16  0

 17  0

 18  0

 19  0

 20  0

 21  0

 22  0

 23  0

 24  0

 25  0

 26  0

 27  0

 28  0

 29  0

 30  0

 31  0

 32  0

  1  0  1  0  0  1       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
  2  0  1  0  0  2       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
  3  0  1  0  0  3       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
  4  0  1  0  0  4       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
  5  0  1  0  0  5       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
  6  0  1  0  0  6       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
  7  0  1  0  0  7       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
  8  0  1  0  0  8       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
  9  0  1  0  0  9       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
 10  0  1  0  0 10       0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
```

```
11  0  1  0  0 11        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
12  0  1  0  0 12        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
13  0  1  0  0 13        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
14  0  1  0  0 14        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
15  0  1  0  0 15        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
16  0  1  0  0 16        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
17  0  1  0  0 17        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
18  0  1  0  0 18        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
19  0  1  0  0 19        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
20  0  1  0  0 20        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
21  0  1  0  0 21        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
22  0  1  0  0 22        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
23  0  1  0  0 23        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
24  0  1  0  0 24        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
25  0  1  0  0 25        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
26  0  1  0  0 26        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
27  0  1  0  0 27        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
28  0  1  0  0 28        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
29  0  1  0  0 29        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
30  0  1  0  0 30        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
31  0  1  0  0 31        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
32  0  1  0  0 32        0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
 1  0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
0.0
093
 0  1  0  6


 1  1  1  1            1  0  0  1  1  1
 2  2  2  2            1  0  0  1  1  2
 3  3  3  3            1  0  0  1  1  3
 4  4  4  4            1  0  0  1  1  4
 5  5  5  5            1  0  0  1  1  5
 6  6  6  6            1  0  0  1  1  6
 7  7  7  7            1  0  0  1  1  7
 8  8  8  8            1  0  0  1  1  8
 9  9  9  9            1  0  0  1  1  9
10 10 10 10            1  0  0  1  1 10
11 11 11 11            1  0  0  1  1 11
12 12 12 12            1  0  0  1  1 12
13 13 13 13            1  0  0  1  1 13
14 14 14 14            1  0  0  1  1 14
15 15 15 15            1  0  0  1  1 15
16 16 16 16            1  0  0  1  1 16
17 17 17 17            1  0  0  1  1 17
18 18 18 18            1  0  0  1  1 18
19 19 19 19            1  0  0  1  1 19
20 20 20 20            1  0  0  1  1 20
21 21 21 21            1  0  0  1  1 21
22 22 22 22            1  0  0  1  1 22
23 23 23 23            1  0  0  1  1 23
24 24 24 24            1  0  0  1  1 24
25 25 25 25            1  0  0  1  1 25
26 26 26 26            1  0  0  1  1 26
27 27 27 27            1  0  0  1  1 27
28 28 28 28            1  0  0  1  1 28
29 29 29 29            1  0  0  1  1 29
30 30 30 30            1  0  0  1  1 30
31 31 31 31            1  0  0  1  1 31
32 32 32 32            1  0  0  1  1 32
 0
999
```

Data file [3] .OPEDID.DATA(GDI1RZ)

RZOUT3 input for 'basic fuel cycle'

```
&ZONE
  NID= 85,6,9
  IDCIT(1,1)=  1,  2,  3,  4,  5,  6,  7,  8,  9, 10,
              11, 12, 13, 14, 15, 16, 17, 18, 19, 20,
              21, 22, 23, 24, 25, 26, 27, 28, 29, 30,
              31, 32, 33, 34, 35, 30, 37, 38, 39, 40,
              41, 42, 43, 44, 45, 46, 47, 48, 49, 50,
              51, 52, 53, 54, 55, 56, 57, 58, 59, 60,
              61, 62, 63, 64, 65, 66, 67, 68, 69, 70,
              71, 72, 73, 74, 75, 76, 77, 78, 79, 80,
              81, 82, 83, 84, 85,   14*0,
  IDSLA(1,1)=949,940,941,942,951,925,926,928,  8, 11,
              26, 24, 28, 42, 25,884,894,  6,157, 40,
             937,939,950,953,962,963,964,965,948,854,
             814,966,967,968,439,579,580,582,584,591,
             603,604,605,606,608,600,617,627,628,620,
             622,631,633,634,644,646,648, 82,839, 12,
              39,441,442,443,529,555,105,115,147,  1,
             402,  4, 13, 63, 73, 74, 20,887,897,857,
             817,889,899,859,819,   14*0,
  IDCIT(1,2)=  10, 11, 12, 13, 14, 15, 93*0,
  IDSLA(1,2)=  11, 26, 24, 28, 42, 25, 93*0,
  IDCIT(1,3)=  10, 11, 12, 13, 14, 15, 18, 67, 68, 90*0,
  IDSLA(1,3)=  11, 26, 24, 28, 42, 25, 6, 105, 115, 90*0,
  NEWZN(1)=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,
           24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,
           44,45,46,47,48,49,50,51,52,38*0,
  ZNGR(1)=32*1,15*2,5*3,
  ISTEP=17,
  NZONE=52,52,
&END
```

Data file [4] .OPFORT.DATA(GDI1RZ)

output from RZOUT3, for 'basic fuel cycle'

```
POC0B17.@GDI1.DENS
 ***************CITATION DATA*****************
  1  1  0  0
  11.46918-3  21.74999-4  39.65638-6  43.30258-7  53.79707-7  66.73607-6
  73.35554-7  82.60913-3  98.90358-3 101.03968-2 111.17896-2 123.28651-3
 132.31220-3 142.61937-4 152.74457-4 160.0       170.0       182.84691-4
 190.0       201.28188-3 212.91854-7 223.71285-7 236.62542-9 241.22009-8
 251.51758-8 263.8220-10 278.5073-10 282.3774-11 294.90057-8 300.0
 310.0       320.0       330.0       340.0       350.0       300.0
 370.0       380.0       390.0       400.0       410.0       420.0
 430.0       440.0       450.0       460.0       470.0       480.0
 490.0       500.0       510.0       520.0       530.0       540.0
 550.0       560.0       570.0       580.0       590.0       600.0
 610.0       620.0       630.0       640.0       650.0       660.0
 672.83107-4 687.74029-4 690.0       702.17919-3 710.0       720.0
 730.0       740.0       750.0       760.0       770.0       789.15262-6
 792.09324-4 801.09239-6 815.96565-6 820.0       830.0       840.0
 850.0
  2  2  0  0
  11.44892-3  21.77607-4  31.00720-5  43.65641-7  53.93013-7  66.62858-6
  73.51142-7  82.60133-3  98.90358-3 101.03968-2 111.17896-2 123.28651-3
 132.31220-3 142.61937-4 152.74457-4 160.0       170.0       182.84691-4
 190.0       201.28188-3 213.68157-7 224.00145-7 237.22962-9 241.38310-8
 251.66777-8 264.3983-10 271.01782-9 282.9681-11 296.21125-8 300.0
 310.0       320.0       330.0       340.0       350.0       300.0
 370.0       380.0       390.0       400.0       410.0       420.0
 430.0       440.0       450.0       460.0       470.0       480.0
 490.0       500.0       510.0       520.0       530.0       540.0
 550.0       560.0       570.0       580.0       590.0       600.0
 610.0       620.0       630.0       640.0       650.0       660.0
 672.78976-4 687.74029-4 690.0       702.17919-3 710.0       720.0
 730.0       740.0       750.0       760.0       770.0       781.17643-5
 792.30406-4 801.18318-6 817.26002-6 820.0       830.0       840.0
 850.0
  3  3  0  0
  11.41403-3  21.84530-4  31.15877-5  44.78984-7  54.44785-7  66.42750-6
  73.88781-7  82.58786-3  98.90358-3 101.03968-2 111.17896-2 123.28651-3

.....................

REPETITIVE DATA REMOVED

.....................

 730.0       740.0       750.0       760.0       770.0       785.88512-6
 791.60877-4 807.03978-7 813.73418-6 820.0       830.0       840.0
 850.0
 31 31  0  0
  11.72898-3  21.72764-4  36.89380-6  41.58220-7  52.83502-7  66.64365-6
  72.17290-7  82.42931-3  98.92030-3 101.03968-2 111.17896-2 123.28651-3
 132.31221-3 142.61937-4 152.74458-4 160.0       170.0       182.84691-4
 190.0       201.28188-3 211.60892-7 222.26524-7 233.37278-9 244.09906-9
 257.45128-9 261.2826-10 271.9069-10 283.6340-12 291.98672-8 300.0
 310.0       320.0       330.0       340.0       350.0       300.0
 370.0       380.0       390.0       400.0       410.0       420.0
 430.0       440.0       450.0       460.0       470.0       480.0
 490.0       500.0       510.0       520.0       530.0       540.0
 550.0       560.0       570.0       580.0       590.0       600.0
 610.0       620.0       630.0       640.0       650.0       660.0
 673.07470-4 687.74028-4 690.0       702.17919-3 710.0       720.0
 730.0       740.0       750.0       760.0       770.0       784.84650-6
 791.50914-4 806.71913-7 813.24357-6 820.0       830.0       840.0
 850.0
 32 32  0  0
  11.72436-3  21.77189-4  38.05075-6  42.02331-7  53.28755-7  66.60039-6
  72.36147-7  82.42788-3  98.92030-3 101.03968-2 111.17896-2 123.28651-3
 132.31221-3 142.61937-4 152.74458-4 160.0       170.0       182.84691-4
 190.0       201.28188-3 211.29464-7 222.40311-7 234.26227-9 246.18931-9
 259.46179-9 261.8090-10 273.1931-10 286.8851-12 292.01640-8 300.0
 310.0       320.0       330.0       340.0       350.0       300.0
 370.0       380.0       390.0       400.0       410.0       420.0
```

```
430.0       440.0       450.0       460.0       470.0       480.0
490.0       500.0       510.0       520.0       530.0       540.0
550.0       560.0       570.0       580.0       590.0       600.0
610.0       620.0       630.0       640.0       650.0       660.0
673.02455-4 687.74029-4 690.0       702.17919-3 710.0       720.0
730.0       740.0       750.0       760.0       770.0       783.83541-6
791.52442-4 806.94562-7 813.06902-6 820.0       830.0       840.0
850.0
33 33  0  0
101.03970-2 111.17900-2 123.28650-3 132.31220-3 142.61950-4 152.74470-4

34 34  0  0
101.03970-2 111.17900-2 123.28650-3 132.31220-3 142.61950-4 152.74470-4

35 35  0  0
101.03970-2 111.17900-2 123.28650-3 132.31220-3 142.61950-4 152.74470-4

36 36  0  0
101.03970-2 111.17900-2 123.28650-3 132.31220-3 142.61950-4 152.74470-4

37 37  0  0
101.03970-2 112.96650-2 128.26930-3 135.81799-3 146.59100-4 156.90610-4

38 38  0  0
101.03970-2 112.96650-2 128.26930-3 135.81799-3 146.59100-4 156.90610-4

39 39  0  0
101.03970-2 112.96650-2 128.26930-3 135.81799-3 146.59100-4 156.90610-4

40 40  0  0
101.03970-2 112.96650-2 128.26930-3 135.81799-3 146.59100-4 156.90610-4

41 41  0  0
101.99080-2 115.24170-3 121.46120-3 131.02800-3 141.16460-4 151.22020-4

42 42  0  0
101.99080-2 115.24170-3 121.46120-3 131.02800-3 141.16460-4 151.22020-4

43 43  0  0
101.99080-2 115.24170-3 121.46120-3 131.02800-3 141.16460-4 151.22020-4

44 44  0  0
101.99080-2 115.24170-3 121.46120-3 131.02800-3 141.16460-4 151.22020-4

45 45  0  0
101.99080-2 115.24170-3 121.46120-3 131.02800-3 141.16460-4 151.22020-4

46 46  0  0
104.38989-3 114.50900-2 121.25690-2 138.84309-3 141.00180-3 151.04970-3

47 47  0  0
104.38990-3 114.50900-2 121.25690-2 138.84310-3 141.00180-3 151.04970-3

48 48  0  0
106.36540-3 111.77540-2 124.94900-3 133.48200-3 143.94460-4 154.13320-4
189.24600-3 677.89610-3 682.90880-2
49 49  0  0
109.32850-3 111.27380-2 123.55070-3 132.49820-3 142.83010-4 152.96540-4
188.22780-3 673.04990-2 682.41210-3
```



```
50 50  0  0
109.32850-3 111.27380-2 123.55070-3 132.49820-3 142.83010-4 152.96540-4
188.22780-3 673.04990-2 682.41210-3
51 51  0  0
109.32850-3 111.27380-2 123.55070-3 132.49820-3 142.83010-4 152.96540-4
188.22780-3 673.04990-2 682.41210-3
52 52  0  0
109.32850-3 111.27380-2 123.55070-3 132.49820-3 142.83010-4 152.96540-4
188.22780-3 673.04990-2 682.41210-3
****************END******************
****************SLAROM DATA******************

ZONE   1
949 1.46918E-03 940 1.74999E-04 941 9.65638E-06 942 3.30258E-07
951 3.79707E-07 925 6.73607E-06 926 3.35554E-07 928 2.60913E-03
  8 8.90358E-03  11 1.03968E-02  26 1.17896E-02  24 3.28651E-03
 28 2.31220E-03  42 2.61937E-04  25 2.74457E-04 884 0.00000E+00
894 0.00000E+00   6 2.84691E-04 157 0.00000E+00  40 1.28188E-03
937 2.91854E-07 939 3.71285E-07 950 6.62542E-09 953 1.22009E-08
962 1.51758E-08 963 3.82196E-10 964 8.50733E-10 965 2.37739E-11
948 4.90057E-08 854 0.00000E+00 814 0.00000E+00 966 0.00000E+00
967 0.00000E+00 968 0.00000E+00 439 0.00000E+00 579 0.00000E+00
580 0.00000E+00 582 0.00000E+00 584 0.00000E+00 591 0.00000E+00
603 0.00000E+00 604 0.00000E+00 605 0.00000E+00 606 0.00000E+00
608 0.00000E+00 600 0.00000E+00 617 0.00000E+00 627 0.00000E+00
628 0.00000E+00 620 0.00000E+00 622 0.00000E+00 631 0.00000E+00
633 0.00000E+00 634 0.00000E+00 644 0.00000E+00 646 0.00000E+00
648 0.00000E+00  82 0.00000E+00 839 0.00000E+00  12 0.00000E+00
 39 0.00000E+00 441 0.00000E+00 442 0.00000E+00 443 0.00000E+00
529 0.00000E+00 555 0.00000E+00 105 2.83107E-04 115 7.74029E-04
147 0.00000E+00   1 2.17919E-03 402 0.00000E+00   4 0.00000E+00
 13 0.00000E+00  63 0.00000E+00  73 0.00000E+00  74 0.00000E+00
 20 0.00000E+00 887 9.15262E-06 897 2.09324E-04 857 1.09239E-06
817 5.96565E-06 889 0.00000E+00 899 0.00000E+00 859 0.00000E+00
819 0.00000E+00

ZONE   2
949 1.44892E-03 940 1.77607E-04 941 1.00720E-05 942 3.65641E-07
951 3.93013E-07 925 6.62858E-06 926 3.51142E-07 928 2.60133E-03
  8 8.90358E-03  11 1.03968E-02  26 1.17896E-02  24 3.28651E-03
 28 2.31220E-03  42 2.61937E-04  25 2.74457E-04 884 0.00000E+00
894 0.00000E+00   6 2.84691E-04 157 0.00000E+00  40 1.28188E-03
937 3.68157E-07 939 4.00145E-07 950 7.22962E-09 953 1.38310E-08
962 1.66777E-08 963 4.39829E-10 964 1.01782E-09 965 2.96814E-11
948 6.21125E-08 854 0.00000E+00 814 0.00000E+00 966 0.00000E+00
967 0.00000E+00 968 0.00000E+00 439 0.00000E+00 579 0.00000E+00
580 0.00000E+00 582 0.00000E+00 584 0.00000E+00 591 0.00000E+00
603 0.00000E+00 604 0.00000E+00 605 0.00000E+00 606 0.00000E+00
608 0.00000E+00 600 0.00000E+00 617 0.00000E+00 627 0.00000E+00
628 0.00000E+00 620 0.00000E+00 622 0.00000E+00 631 0.00000E+00
633 0.00000E+00 634 0.00000E+00 644 0.00000E+00 646 0.00000E+00
648 0.00000E+00  82 0.00000E+00 839 0.00000E+00  12 0.00000E+00
 39 0.00000E+00 441 0.00000E+00 442 0.00000E+00 443 0.00000E+00
529 0.00000E+00 555 0.00000E+00 105 2.78976E-04 115 7.74029E-04
147 0.00000E+00   1 2.17919E-03 402 0.00000E+00   4 0.00000E+00
 13 0.00000E+00  63 0.00000E+00  73 0.00000E+00  74 0.00000E+00
 20 0.00000E+00 887 1.17643E-05 897 2.30406E-04 857 1.18318E-06
817 7.26002E-06 889 0.00000E+00 899 0.00000E+00 859 0.00000E+00
819 0.00000E+00
```

```
 ZONE   3
 949 1.41403E-03 940 1.84530E-04 941 1.15877E-05 942 4.78984E-07
 951 4.44785E-07 925 6.42750E-06 926 3.88781E-07 928 2.58786E-03

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REPETITIVE DATA REMOVED

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 20 0.00000E+00 887 4.84650E-06 897 1.50914E-04 857 6.71913E-07
 817 3.24357E-06 889 0.00000E+00 899 0.00000E+00 859 0.00000E+00
 819 0.00000E+00

 ZONE  32
 949 1.72436E-03 940 1.77189E-04 941 8.05075E-06 942 2.02331E-07
 951 3.28755E-07 925 6.60039E-06 926 2.36147E-07 928 2.42788E-03
   8 8.92030E-03  11 1.03968E-02  26 1.17896E-02  24 3.28651E-03
  28 2.31221E-03  42 2.61937E-04  25 2.74458E-04 884 0.00000E+00
 894 0.00000E+00   6 2.84691E-04 157 0.00000E+00  40 1.28188E-03
 937 1.29464E-07 939 2.40311E-07 950 4.26227E-09 953 6.18931E-09
 962 9.46179E-09 963 1.80899E-10 964 3.19306E-10 965 6.88508E-12
 948 2.01640E-08 854 0.00000E+00 814 0.00000E+00 966 0.00000E+00
 967 0.00000E+00 968 0.00000E+00 439 0.00000E+00 579 0.00000E+00
 580 0.00000E+00 582 0.00000E+00 584 0.00000E+00 591 0.00000E+00
 603 0.00000E+00 604 0.00000E+00 605 0.00000E+00 606 0.00000E+00
 608 0.00000E+00 600 0.00000E+00 617 0.00000E+00 627 0.00000E+00
 628 0.00000E+00 620 0.00000E+00 622 0.00000E+00 631 0.00000E+00
 633 0.00000E+00 634 0.00000E+00 644 0.00000E+00 646 0.00000E+00
 648 0.00000E+00  82 0.00000E+00 839 0.00000E+00  12 0.00000E+00
  39 0.00000E+00 441 0.00000E+00 442 0.00000E+00 443 0.00000E+00
 529 0.00000E+00 555 0.00000E+00 105 3.02455E-04 115 7.74029E-04
 147 0.00000E+00   1 2.17919E-03 402 0.00000E+00   4 0.00000E+00
  13 0.00000E+00  63 0.00000E+00  73 0.00000E+00  74 0.00000E+00
  20 0.00000E+00 887 3.83541E-06 897 1.52442E-04 857 6.94562E-07
 817 3.06902E-06 889 0.00000E+00 899 0.00000E+00 859 0.00000E+00
 819 0.00000E+00

 ZONE  33
  11 1.03970E-02  26 1.17900E-02  24 3.28650E-03  28 2.31220E-03
  42 2.61950E-04  25 2.74470E-04

 ZONE  34
  11 1.03970E-02  26 1.17900E-02  24 3.28650E-03  28 2.31220E-03
  42 2.61950E-04  25 2.74470E-04

 ZONE  35

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REPETITIVE DATA REMOVED

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 ZONE  47
  11 4.38990E-03  26 4.50900E-02  24 1.25690E-02  28 8.84310E-03
  42 1.00180E-03  25 1.04970E-03

 ZONE  48
  11 6.36540E-03  26 1.77540E-02  24 4.94900E-03  28 3.48200E-03
  42 3.94460E-04  25 4.13320E-04   6 9.24600E-03 105 7.89610E-03
 115 2.90880E-02

 ZONE  49
  11 9.32850E-03  26 1.27380E-02  24 3.55070E-03  28 2.49820E-03
  42 2.83010E-04  25 2.96540E-04   6 8.22780E-03 105 3.04990E-02
 115 2.41210E-03

 ZONE  50
  11 9.32850E-03  26 1.27380E-02  24 3.55070E-03  28 2.49820E-03
  42 2.83010E-04  25 2.96540E-04   6 8.22780E-03 105 3.04990E-02
 115 2.41210E-03

 ZONE  51
  11 9.32850E-03  26 1.27380E-02  24 3.55070E-03  28 2.49820E-03
  42 2.83010E-04  25 2.96540E-04   6 8.22780E-03 105 3.04990E-02
 115 2.41210E-03

 ZONE  52
  11 9.32850E-03  26 1.27380E-02  24 3.55070E-03  28 2.49820E-03
  42 2.83010E-04  25 2.96540E-04   6 8.22780E-03 105 3.04990E-02
 115 2.41210E-03
 ****************END*********************
```

Data file [5] .OPDEND.DATA(GDG0S)

SLAROM input for 'iterative condensation'

```
PREP
 INNER CORE  1,CORE 7,HQPU39.86/44.86%,4*9.75,165%,31/4ZRH,BOC GDG0
  2  1  0  1  1  0  3 -20  0  0  0  0 70
 10703.15 1.3 0.0
 1373.15 703.15
    77     8
 0.30705  0.30160
 949 0.549351E-02 940 0.735227E-03 941 0.486471E-04 942 0.214555E-05
 951 0.185357E-05 925 0.252666E-04 926 0.161152E-05 928 0.102704E-01
   8 0.351686E-01 884 0.000000E+00 894 0.000000E+00   6 0.111864E-02
 157 0.000000E+00 937 0.179786E-05 939 0.191532E-05 950 0.406384E-07
 953 0.984156E-07 962 0.959287E-07 963 0.304819E-08 964 0.895688E-08
 965 0.322166E-09 948 0.363717E-06 854 0.000000E+00 814 0.000000E+00
 966 0.000000E+00 967 0.000000E+00 968 0.000000E+00 439 0.000000E+00
 579 0.000000E+00 580 0.000000E+00 582 0.000000E+00 584 0.000000E+00
 591 0.000000E+00 603 0.000000E+00 604 0.000000E+00 605 0.000000E+00
 606 0.000000E+00 608 0.000000E+00 600 0.000000E+00 617 0.000000E+00
 627 0.000000E+00 628 0.000000E+00 620 0.000000E+00 622 0.000000E+00
 631 0.000000E+00 633 0.000000E+00 634 0.000000E+00 644 0.000000E+00
 646 0.000000E+00 648 0.000000E+00  82 0.000000E+00 839 0.000000E+00
  12 0.000000E+00  39 0.000000E+00 441 0.000000E+00 442 0.000000E+00
 443 0.000000E+00 529 0.000000E+00 555 0.000000E+00 105 0.104222E-02
 115 0.304139E-02 147 0.000000E+00 402 0.000000E+00   4 0.000000E+00
  13 0.000000E+00  63 0.000000E+00  73 0.000000E+00  74 0.000000E+00
```

```
 20 0.000000E+00 887 0.591615E-04 897 0.107694E-02 857 0.554935E-05
817 0.393071E-04 889 0.000000E+00 899 0.000000E+00 859 0.000000E+00
819 0.000000E+00

 11 0.139463E-01  26 0.158146E-01  24 0.440851E-02  28 0.310159E-02
 42 0.351362E-03  25 0.368157E-03  40 0.164787E-02   1 0.280137E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.60865
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
INCORE
PREP
 OUTER CORE  2,CORE 7,HQPU39.86/44.86%,4*9.75,165%,31/4ZRH,BOC GDG0
  2  1  0  1  1  0  3 -20  0  0  0  0 70
 10703.15 1.3 0.0
 1373.15 703.15
    77     8
 0.30705  0.26171
 949 0.567654E-02 940 0.637067E-03 941 0.306210E-04 942 0.958221E-06
 951 0.122012E-05 925 0.218034E-04 926 0.957798E-06 928 0.833109E-02
   8 0.307707E-01 884 0.000000E+00 894 0.000000E+00   6 0.976832E-03
 157 0.000000E+00 937 0.115092E-05 939 0.109166E-05 950 0.193127E-07
 953 0.306155E-07 962 0.439324E-07 963 0.100419E-08 964 0.197616E-08
 965 0.510089E-10 948 0.165980E-06 854 0.000000E+00 814 0.000000E+00
 966 0.000000E+00 967 0.000000E+00 968 0.000000E+00 439 0.000000E+00
 579 0.000000E+00 580 0.000000E+00 582 0.000000E+00 584 0.000000E+00
 591 0.000000E+00 603 0.000000E+00 604 0.000000E+00 605 0.000000E+00
 606 0.000000E+00 608 0.000000E+00 600 0.000000E+00 617 0.000000E+00
 627 0.000000E+00 628 0.000000E+00 620 0.000000E+00 622 0.000000E+00
 631 0.000000E+00 633 0.000000E+00 634 0.000000E+00 644 0.000000E+00
 646 0.000000E+00 648 0.000000E+00  82 0.000000E+00 839 0.000000E+00
  12 0.000000E+00  39 0.000000E+00 441 0.000000E+00 442 0.000000E+00
 443 0.000000E+00 529 0.000000E+00 555 0.000000E+00 105 0.100026E-02
 115 0.265585E-02 147 0.000000E+00 402 0.000000E+00   4 0.000000E+00
  13 0.000000E+00  63 0.000000E+00  73 0.000000E+00  74 0.000000E+00
  20 0.000000E+00 887 0.365056E-04 897 0.775911E-03 857 0.329013E-05
 817 0.236091E-04 889 0.000000E+00 899 0.000000E+00 859 0.000000E+00
 819 0.000000E+00

 11 0.146730E-01  26 0.166387E-01  24 0.463825E-02  28 0.326322E-02
 42 0.369672E-03  25 0.387342E-03  40 0.173374E-02   1 0.294733E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.56876
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
OTCORE
PREP
PLENUM UP&LO,LO Q PU,165%FUEL,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 1.17900E-02  24 3.28650E-03  28 2.31220E-03
   42 2.61950E-04  25 2.74470E-04
PLENUM
PREP
PLUGGED PIN, LO Q ,165%FUEL
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 2.96650E-02  24 8.26930E-03  28 5.81800E-03
   42 6.59100E-04  25 6.90610E-04
PLUGGD
PREP
ROD FOLLOWER/GAP,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.99080E-02  26 5.24170E-03  24 1.46120E-03  28 1.02800E-03
   42 1.16460E-04  25 1.22020E-04
FOLLOW
PREP
UPP/RAD'L SH'LD,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 4.38990E-03  26 4.50900E-02  24 1.25690E-02  28 8.84310E-03
   42 1.00180E-03  25 1.04970E-03
UPPSHD
PREP
LOWER SHIELD,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  9
 1.0
   11 6.36540E-03  26 1.77540E-02  24 4.94900E-03  28 3.48200E-03
   42 3.94460E-04  25 4.13320E-04   6 9.24600E-03 105 7.89610E-03
  115 2.90880E-02
LOWSHD
PREP
ABSORBER ROD,     HETEROGENEOUS CELL MODEL   WITHIN 9.7 S/A FUEL
  6  1  0  1  1  0  3 -21  0  0  0  0 70
 703.15 1.3 0.0
  3  1  5  1  5  30
 4.7901  0.1137  0.9751  2.1419  0.3937  18.8519
    6 2.47080E-02 105 9.15890E-02 115 7.24350E-03 /
   11 2.19495E-09 /
```

```
                  26 5.63630E-02  24 1.57110E-02  28 1.10540E-02
   42 1.25230E-03  25 1.31210E-03 /
   11 2.19495E-02 /
                  26 5.63630E-02  24 1.57110E-02  28 1.10540E-02
   42 1.25230E-03  25 1.31210E-03 /
  949 6.49311E-04 940 8.17696E-04 941 1.68546E-04 942 3.13512E-04
  951 1.94612E-05 925 7.78987E-06 926 3.61466E-07 928 2.99340E-03
    8 1.03332E-02  11 1.18383E-02  26 1.07946E-02  24 3.00913E-03
   28 2.11706E-03  42 2.39830E-04  25 2.51294E-04
   40 6.79872E-04
  937 3.26805E-07 939 6.64538E-07 950 4.94608E-07 953 1.17133E-05
  962 1.13309E-06 963 4.51328E-08 964 1.29052E-06 965 4.89657E-08
  948 6.45035E-05
    1 1.15578E-03
  887 1.02518E-05 897 8.98626E-05 857 1.21029E-06
  817 6.73348E-05 /

PATH
 TITLE CARD  HETEROGENEOUS ROD
 70  6  2  1  1  0  0
 3  6  6  0  6  0  0  0  0  0  8 10  0  0 15  0
 1  2  3  4  5  6
 0.0  4.7901  4.9038  5.7652  7.9071  8.3008  27.1527
PIJF
 37  0  5  3  0  1  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
 2  2  1  1  0
 1  5  1  5
ABSORB
PREP
ROD ABSORBER HOMOGENEOUE  PFC1  LOQ  160%, 4*9MONTH 30/0PIN ZRH
  1  1  0  0  0  0  3 -20  0  0  0  0 70
  703.15  0.0  0.0
 9
 1.0
   11 9.32849E-03  26 1.27380E-02  24 3.55070E-03  28 2.49820E-03
   42 2.83010E-04  25 2.96540E-04   6 8.22779E-03 105 3.04990E-02
  115 2.41210E-03
AHOMOG
```

Data file [6] .OPCITD.DATA(PHA1N70)

CITATION input for 'iterative condensation'

```
CITATION                                                                  00000010
INCOR     SLAROM                                                          00000120
  600MW / 60 CM PU BURNING CORE , PU VECTOR STUDY , HIGH QUALITY PU
   CORE VII     DSD RODS 0%     CSD RODS 30%                PHA1 IT. 1
001
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0
  1  0  0  0  1  0  0  1  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0
```



```
003
 0  0  0  0  7  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
   1.0000E-4   1.0000E-5

004
 10 46.21720  1  4.27490  7 38.52480  1  2.2926   1  2.2365   7 38.48690
  1  4.61620  6 28.74400  1  1.24510  1  2.4628   6 30.29210  8 42.20000

 10 50.00000  2  7.00000  1  3.00000  2  5.00000  6 18.00000 1442.00000
  1  2.00000 14 70.00000  6 33.00000
005
  6  8  6  8  8  6  8  6  8  8  6  6
  5  8  5  8  8  5  8  5  8  8  5  6
  4  8  4  8  8  4  8  4  8  8  4  6
  3  8  3  8  8  3  8  3  8  8  3  6
  1  8  1  8  5  1  8  2  5  8  2  6
  1  5  1  5  5  1  5  2  5  5  2  6
  4  5  4  5  5  4  5  4  5  5  4  6
  3  5  3  5  5  3  5  3  5  5  3  6
  7  7  7  7  7  7  7  7  7  7  7  6
008                                                                       00000270
-70 70  0  8  2  1  1  3                                                  00000280
  1                                                                       00000290
INCOR     SLAROM                                                          00000120
  2                                                                       00000290
OTCOR     SLAROM                                                          00000120
  3                                                                       00000290
PLENU     SLAROM                                                          00000120
  4                                                                       00000290
PLUGG     SLAROM                                                          00000120
  5                                                                       00000290
FOLLO     SLAROM                                                          00000120
  6                                                                       00000290
UPPSH     SLAROM                                                          00000120
  7                                                                       00000290
LOWSH     SLAROM                                                          00000120
  8                                                                       00000290
ABSOR     SLAROM                                                          00000120
                                                                          00000290
INCOR     SLAROM                                                          00000120
023                                                                       00000910
  0  0  0  7                                                             00000920
999                                                                       00000960
```

Data file [7] .OPEDID.DATA(PFC1F)

flux extract JOINT input for 'iterative condensation'

```
CITATIONPOST

0
 70   8  1  0
```

```
INCOR                                                                00000120
OTCOR                                                                00000120
PLENU                                                                00000120
PLUGG                                                                00000120
FOLLO                                                                00000120
UPPSH                                                                00000120
LOWSH                                                                00000120
ABSOR                                                                00000120
```

Data file [8] .OPEDID.DATA(PFC1C)

condensation JOINT input, 7 groups, for 'iterative condensation'

```
CITATIONPOST                                                         00000010
                                                                     00000020
1                                                                    00000030
 7                                                                   00000040
  4  8 19 28 37 46 70                                               00000050
PDSIN    INCOR   SLAR  0  1                                         00000060
PDSOUT   INCOR   SLAR                                               00000070
USERPDS INCOR    CITA                                               00000080
 INNER-CORE       OPTIMIZED CORE                                     00000020
PDSIN    OTCOR   SLAR  0  1                                         00000060
PDSOUT   OTCOR   SLAR                                               00000070
USERPDS OTCOR    CITA                                               00000080
 OUTER-CORE       OPTIMIZED CORE                                     00000020
PDSIN    PLENU   SLAR  0  1                                         00000060
PDSOUT   PLENU   SLAR                                               00000070
USERPDS PLENU    CITA                                               00000080
 PLENUM           OPTIMIZED CORE                                     00000020
PDSIN    PLUGG   SLAR  0  1                                         00000060
PDSOUT   PLUGG   SLAR                                               00000070
USERPDS PLUGG    CITA                                               00000080
 STEEL PLUG       OPTIMIZED CORE                                     00000020
PDSIN    FOLLO   SLAR  0  1                                         00000060
PDSOUT   FOLLO   SLAR                                               00000070
USERPDS FOLLO    CITA                                               00000080
 ROD FOLLOWER     OPTIMIZED CORE                                     00000020
PDSIN    UPPSH   SLAR  0  1                                         00000060
PDSOUT   UPPSH   SLAR                                               00000070
USERPDS UPPSH    CITA                                               00000080
 UPPER-SH'D       OPTIMIZED CORE                                     00000020
PDSIN    LOWSH   SLAR  0  1                                         00000060
PDSOUT   LOWSH   SLAR                                               00000070
USERPDS LOWSH    CITA                                               00000080
 RAD'L-SH'D       OPTIMIZED CORE                                     00000020
PDSIN    ABSOR   SLAR  0  1                                         00000060
PDSOUT   ABSOR   SLAR                                               00000070
USERPDS ABSOR    CITA                                               00000080
 ROD ABS-HET      OPTIMIZED CORE                                     00000020
PDSIN    AHOMO   SLAR  0  1                                         00000060
PDSOUT   AHOMO   SLAR                                               00000070
USERPDS ABSOR    CITA                                               00000080
```



```
 ROD ABS-HOMO     OPTIMIZED CORE                                     00000020
```

Data file [9] .OPEDID.DATA(PFC1M)

x-section re-formatting JOINT input for 'iterative condensation'

```
CITATIONMICRO                                                        00000100
INCOR     SLAROM                                                     00000200
 85                                                                  00000300
   1 949  PU239     239.0530    0.334000E-10                         00000400
   2 940  PU240     240.0540    0.336   E-10                         00000410
   3 941  PU241     241.0570    0.337   E-10                         00000420
   4 942  PU242     242.0580    0.338   E-10                         00000420
   5 951  AM241     241.0750    0.336   E-10                         00000420
   6 925   U235     235.0440    0.323   E-10                         00000420
   7 926   U236     236.0460    0.324   E-10                         00000420
   8 928   U238     238.0510    0.331   E-10                         00000420
   9   8   O         15.9994    0.0                                  00000420
  10  11   NA        22.9898    0.0                                  00000420
  11  26   FE        55.8470    0.0                                  00000420
  12  24   CR        51.9961    0.0                                  00000400
  13  28   NI        58.6900    0.0                                  00000410
  14  42   MO        95.9400    0.0                                  00000420
  15  25   MN        54.9380    0.0                                  00000420
  16 884   U-238FP   238.0       0.0                                 00000420
  17 894   PU-239FP  239.0       0.0                                 00000420
  18   6   C         12.011     0.0                                  00000420
  19 157   N15       15.000     0.0                                  00000420
  20  40   ZR        91.224     0.0
  21 937  NP237     237.048     0.330000E-10
  22 939  NP239     239.053     0.331000E-10
  23 950  AM242M    242.060     0.345000E-10
  24 953  AM243     243.061     0.346000E-10
  25 962  CM242     242.059     0.352000E-10
  26 963  CM243     243.060     0.352000E-10
  27 964  CM244     244.063     0.353000E-10
  28 965  CM245     245.066     0.353000E-10
  29 948  PU238     238.050     0.337000E-10
  30 854  U235-FP   235.0       0.0
  31 814  PU241-FP  241.0       0.0
  32 966  CM246     246.0       0.354000E-10
  33 967  CM247     247.0       0.354000E-10
  34 968  CM248     248.0       0.354000E-10
  35 439  TC99       99.0       0.0
  36 579  LA139     139.0       0.0
  37 580  CE140     140.0       0.0
  38 582  CE142     142.0       0.0
  39 584  CE144     144.0       0.0
  40 591  PR141     141.0       0.0
  41 603  ND143     143.0       0.0
  42 604  ND144     144.0       0.0
  43 605  ND145     145.0       0.0
  44 606  ND146     146.0       0.0
```

```
 45 608  ND148      148.0        0.0
 46 600  ND150      150.0        0.0
 47 617  PM147      146.915      0.0
 48 627  SM147      147.0        0.0
 49 628  SM148      148.0        0.0
 50 620  SM150      150.0        0.0
 51 622  SM152      152.0        0.0
 52 631  EU151      150.919      0.0
 53 633  EU153      152.921      0.0
 54 634  EU154      154.0        0.0
 55 644  GD154      154.0        0.0
 56 646  GD156      155.922      0.0
 57 648  GD158      157.924      0.0
 58  82  PB56       207.2        0.0
 59 839  BI209      209.0        0.0
 60  12  MG         24.305       0.0
 61  39  Y          88.9069      0.0
 62 441  RU101      100.906      0.0
 63 442  RU102      101.904      0.0
 64 443  RU103      102.906      0.0
 65 529  I129       128.905      0.0
 66 555  CS135      134.906      0.0
 67 105  B10        10.0129      0.0                                    00000420
 68 115  B11        11.0093      0.0                                    00000420
 69 147  N14        14.0031      0.0
 70   1  H           1.0078      0.0
 71 402  HE          4.0026      0.0
 72   4  BE          9.0122      0.0
 73  13  AL27       26.9818      0.0
 74  63  LI6         6.0151      0.0
 75  73  LI7         7.0160      0.0
 76  74  W-NAT     183.8500      0.0
 77  20  CA         40.0800      0.0
 78 887  U238-FP    238.0        0.0
 79 897  PU239-FP   239.0        0.0
 80 857  U235-FP    235.0        0.0
 81 817  PU241-FP   241.0        0.0
 82 889  U238-FP    238.0        0.0
 83 899  PU239-FP   239.0        0.0
 84 859  U235-FP    235.0        0.0
 85 819  PU241-FP   241.0        0.0
INCOR        85 INNE CORE REGION
  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 2400000280
 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72
 73 74 75 76 77 78 79 80 81 82 83 84 85
OTCOR        85  OUT CORE REGION
  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 2400000280
 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72
 73 74 75 76 77 78 79 80 81 82 83 84 85
PLENU         6  PLENUM                                                  00000310
 10 11 12 13 14 15                                                      00000280
PLUGG         6  STEEL PLUG                                             00000310
 10 11 12 13 14 15                                                      00000280
FOLLO         6  ROD FOLLOWER                                          00000320
 10 11 12 13 14 15                                                      00000280
UPPSH         6  UPPER SHIELD                                           00000310
 10 11 12 13 14 15                                                      00000280
LOWSH         9  LOWER   SHIELD                                        00000310
 10 11 12 13 14 15 18 67 68                                             00000280
ABSOR         9  ROD ABS-HET                                           00000320
 10 11 12 13 14 15 18 67 68                                             00000280
AHOMO         9  ROD ABS-HOMO                                          00000320
 10 11 12 13 14 15 18 67 68                                             00000280
                                                                        00000900
```

Data file [10] .OPDEND.DATA(GDI1S)

SLAROM input for 'basic fuel cycle'

```
PREP
 INNER CORE  1,C7,HPU40.25/45.03%,4*9.75M,165%,24/8ZRH/B4CP,SOC GDI1
  2  1  0  1  1  0  3   0  0  0  0  0 70
10703.15 1.3 0.0
1373.15 703.15
   77     8
0.30705  0.30160
949 0.577285E-02 940 0.687624E-03 941 0.379428E-04 942 0.129768E-05
951 0.149198E-05 925 0.264680E-04 926 0.131849E-05 928 0.102521E-01
  8 0.349848E-01 884 0.000000E+00 894 0.000000E+00   6 0.111864E-02
157 0.000000E+00 937 0.114678E-05 939 0.145889E-05 950 0.260333E-07
953 0.479410E-07 962 0.596302E-07 963 0.150176E-08 964 0.334279E-08
965 0.934148E-10 948 0.192558E-06 854 0.000000E+00 814 0.000000E+00
966 0.000000E+00 967 0.000000E+00 968 0.000000E+00 439 0.000000E+00
579 0.000000E+00 580 0.000000E+00 582 0.000000E+00 584 0.000000E+00
591 0.000000E+00 603 0.000000E+00 604 0.000000E+00 605 0.000000E+00
606 0.000000E+00 608 0.000000E+00 600 0.000000E+00 617 0.000000E+00
627 0.000000E+00 628 0.000000E+00 620 0.000000E+00 622 0.000000E+00
631 0.000000E+00 633 0.000000E+00 634 0.000000E+00 644 0.000000E+00
646 0.000000E+00 648 0.000000E+00  82 0.000000E+00 839 0.000000E+00
 12 0.000000E+00  39 0.000000E+00 441 0.000000E+00 442 0.000000E+00
443 0.000000E+00 529 0.000000E+00 555 0.000000E+00 105 0.111241E-02
115 0.304139E-02 147 0.000000E+00 402 0.000000E+00   4 0.000000E+00
 13 0.000000E+00  63 0.000000E+00  73 0.000000E+00  74 0.000000E+00
 20 0.000000E+00 887 0.359634E-04 897 0.822497E-03 857 0.429233E-05
817 0.234408E-04 889 0.000000E+00 899 0.000000E+00 859 0.000000E+00
819 0.000000E+00

 11 0.139463E-01  26 0.158146E-01  24 0.440852E-02  28 0.310159E-02
 42 0.351362E-03  25 0.368157E-03  40 0.171951E-02   1 0.292317E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.60865
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
```

```
  2  2  1  0  0
IC01FF
PREP
 INNER CORE  2,C7,HPU40.25/45.03%,4*9.75M,165%,24/8ZRH/B4CP,SOC GDI1
  2  1  0  1  1  0  3   0  0  0  0  0 70
 10703.15 1.3 0.0
 1373.15 703.15
    77     8
 0.30705  0.30160
 949 0.569324E-02 940 0.697871E-03 941 0.395759E-04 942 0.143671E-05
 951 0.154427E-05 925 0.260457E-04 926 0.137974E-05 928 0.102214E-01
   8 0.349848E-01 884 0.000000E+00 894 0.000000E+00   6 0.111864E-02
 157 0.000000E+00 937 0.144660E-05 939 0.157229E-05 950 0.284073E-07
 953 0.543461E-07 962 0.655317E-07 963 0.172822E-08 964 0.399932E-08
 965 0.116627E-09 948 0.244059E-06 854 0.000000E+00 814 0.000000E+00
 966 0.000000E+00 967 0.000000E+00 968 0.000000E+00 439 0.000000E+00
 579 0.000000E+00 580 0.000000E+00 582 0.000000E+00 584 0.000000E+00
 591 0.000000E+00 603 0.000000E+00 604 0.000000E+00 605 0.000000E+00
 606 0.000000E+00 608 0.000000E+00 600 0.000000E+00 617 0.000000E+00
 627 0.000000E+00 628 0.000000E+00 620 0.000000E+00 622 0.000000E+00
 631 0.000000E+00 633 0.000000E+00 634 0.000000E+00 644 0.000000E+00
 646 0.000000E+00 648 0.000000E+00  82 0.000000E+00 839 0.000000E+00
  12 0.000000E+00  39 0.000000E+00 441 0.000000E+00 442 0.000000E+00
 443 0.000000E+00 529 0.000000E+00 555 0.000000E+00 105 0.109618E-02
 115 0.304139E-02 147 0.000000E+00 402 0.000000E+00   4 0.000000E+00
  13 0.000000E+00  63 0.000000E+00  73 0.000000E+00  74 0.000000E+00
  20 0.000000E+00 887 0.462255E-04 897 0.905334E-03 857 0.464907E-05
 817 0.285268E-04 889 0.000000E+00 899 0.000000E+00 859 0.000000E+00
 819 0.000000E+00

  11 0.139463E-01  26 0.158146E-01  24 0.440852E-02  28 0.310159E-02
  42 0.351362E-03  25 0.368157E-03  40 0.171951E-02   1 0.292317E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.60865
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
IC02FF
PREP
 INNER CORE  3,C7,HPU40.25/45.03%,4*9.75M,165%,24/8ZRH/B4CP,SOC GDI1
  2  1  0  1  1  0  3   0  0  0  0  0 70

.....

REPETITIVE DATA REMOVED
.....

OC31FF
PREP
 OUTER CORE 32,C7,HPU40.25/45.03%,4*9.75M,165%,24/8ZRH/B4CP,SOC GDI1
  2  1  0  1  1  0  3   0  0  0  0  0 70
```



```
 10703.15 1.3 0.0
 1373.15 703.15
    77     8
 0.30705  0.26171
 949 0.591662E-02 940 0.607971E-03 941 0.276237E-04 942 0.694238E-06
 951 0.112802E-05 925 0.226472E-04 926 0.810268E-06 928 0.833054E-02
   8 0.306073E-01 884 0.000000E+00 894 0.000000E+00   6 0.976832E-03
 157 0.000000E+00 937 0.444217E-06 939 0.824555E-06 950 0.146247E-07
 953 0.212368E-07 962 0.324653E-07 963 0.620701E-09 964 0.109560E-08
 965 0.236241E-10 948 0.691867E-07 854 0.000000E+00 814 0.000000E+00
 966 0.000000E+00 967 0.000000E+00 968 0.000000E+00 439 0.000000E+00
 579 0.000000E+00 580 0.000000E+00 582 0.000000E+00 584 0.000000E+00
 591 0.000000E+00 603 0.000000E+00 604 0.000000E+00 605 0.000000E+00
 606 0.000000E+00 608 0.000000E+00 600 0.000000E+00 617 0.000000E+00
 627 0.000000E+00 628 0.000000E+00 620 0.000000E+00 622 0.000000E+00
 631 0.000000E+00 633 0.000000E+00 634 0.000000E+00 644 0.000000E+00
 646 0.000000E+00 648 0.000000E+00  82 0.000000E+00 839 0.000000E+00
  12 0.000000E+00  39 0.000000E+00 441 0.000000E+00 442 0.000000E+00
 443 0.000000E+00 529 0.000000E+00 555 0.000000E+00 105 0.103778E-02
 115 0.265585E-02 147 0.000000E+00 402 0.000000E+00   4 0.000000E+00
  13 0.000000E+00  63 0.000000E+00  73 0.000000E+00  74 0.000000E+00
  20 0.000000E+00 887 0.131601E-04 897 0.523059E-03 857 0.238318E-05
 817 0.105304E-04 889 0.000000E+00 899 0.000000E+00 859 0.000000E+00
 819 0.000000E+00

  11 0.146730E-01  26 0.166387E-01  24 0.463825E-02  28 0.326322E-02
  42 0.369672E-03  25 0.387342E-03  40 0.180912E-02   1 0.307549E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.56876
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
OC32FF
PREP
PLENUM ,LO Q PU,165%FUEL, UPPER INNER
  1  1  0  0  0  0  3   0  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 1.17900E-02  24 3.28650E-03  28 2.31220E-03
   42 2.61950E-04  25 2.74470E-04
UIPLNN
PREP
PLENUM ,LO Q PU,165%FUEL,  UPPER OUTER
  1  1  0  0  0  0  3   0  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 1.17900E-02  24 3.28650E-03  28 2.31220E-03
   42 2.61950E-04  25 2.74470E-04
UOPLNN
```

```
PREP

.....................

REPETITIVE DATA REMOVED
.....................


IRDSHD
PREP
LOWER SHIELD,
  1  1  0  0  0  0  3   0  0  0  0  0 70
 703.15 0.0 0.0
  9
 1.0
   11 6.36540E-03  26 1.77540E-02  24 4.94900E-03  28 3.48200E-03
   42 3.94460E-04  25 4.13320E-04   6 9.24600E-03 105 7.89610E-03
  115 2.90880E-02
LSHLDD
PREP
ABSORBER ROD 1,  HETEROGENEOUS CELL MODEL   WITHIN 9.7 S/A FUEL
  6  1  0  1  1  0  3   0  0  0  0  0 70
 703.15 1.3 0.0
  3  1  5  1  5  30
 4.7901  0.1137  0.9751  2.1419  0.3937  18.8519
    6 2.47080E-02 105 9.15890E-02 115 7.24350E-03 /
   11 2.19495E-09 /
                  26 5.63630E-02  24 1.57110E-02  28 1.10540E-02
   42 1.25230E-03  25 1.31210E-03 /
   11 2.19495E-02 /
                  26 5.63630E-02  24 1.57110E-02  28 1.10540E-02
   42 1.25230E-03  25 1.31210E-03 /
  949 6.49311E-04 940 8.17696E-04 941 1.68546E-04 942 3.13512E-04
  951 1.94612E-05 925 7.78987E-06 926 3.61466E-07 928 2.99340E-03
    8 1.03332E-02  11 1.18383E-02  26 1.07946E-02  24 3.00913E-03
   28 2.11706E-03  42 2.39830E-04  25 2.51294E-04
   40 6.79872E-04
  937 3.26805E-07 939 6.64538E-07 950 4.94608E-07 953 1.17133E-05
  962 1.13309E-06 963 4.51328E-08 964 1.29052E-06 965 4.89657E-08
  948 6.45035E-05
    1 1.15578E-03
  887 1.02518E-05 897 8.98626E-05 857 1.21029E-06
  817 6.73348E-05 /

PATH
 TITLE CARD  HETEROGENEOUS ROD
 70  6  2  1  1  0  0
 3  6  6  0  6  0  0  0  0  0  0  8 10  0  0 15  0
 1  2  3  4  5  6
 0.0  4.7901  4.9038  5.7652  7.9071  8.3008  27.1527
PIJF
 37  0  5  3  0  1  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
 2  2  1  1  0
 1  5  1  5
RODI1A
PREP
```



```
ABSORBER ROD 2,  HETEROGENEOUS CELL MODEL   WITHIN 9.7 S/A FUEL
  6  1  0  1  1  0  3   0  0  0  0  0 70
 703.15 1.3 0.0
  3  1  5  1  5  30
 4.7901  0.1137  0.9751  2.1419  0.3937  18.8519
    6 2.47080E-02 105 9.15890E-02 115 7.24350E-03 /
   11 2.19495E-09 /
                  26 5.63630E-02  24 1.57110E-02  28 1.10540E-02
   42 1.25230E-03  25 1.31210E-03 /
   11 2.19495E-02 /
                  26 5.63630E-02  24 1.57110E-02  28 1.10540E-02
   42 1.25230E-03  25 1.31210E-03 /
  949 6.49311E-04 940 8.17696E-04 941 1.68546E-04 942 3.13512E-04
  951 1.94612E-05 925 7.78987E-06 926 3.61466E-07 928 2.99340E-03
    8 1.03332E-02  11 1.18383E-02  26 1.07946E-02  24 3.00913E-03
   28 2.11706E-03  42 2.39830E-04  25 2.51294E-04
   40 6.79872E-04
  937 3.26805E-07 939 6.64538E-07 950 4.94608E-07 953 1.17133E-05
  962 1.13309E-06 963 4.51328E-08 964 1.29052E-06 965 4.89657E-08
  948 6.45035E-05
    1 1.15578E-03
  887 1.02518E-05 897 8.98626E-05 857 1.21029E-06
  817 6.73348E-05 /

PATH
 TITLE CARD  HETEROGENEOUS ROD
 70  6  2  1  1  0  0
 3  6  6  0  6  0  0  0  0  0  0  8 10  0  0 15  0
 1  2  3  4  5  6
 0.0  4.7901  4.9038  5.7652  7.9071  8.3008  27.1527
PIJF
 37  0  5  3  0  1  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
 2  2  1  1  0
 1  5  1  5
RODI2A
PREP

.....................

REPETITIVE DATA REMOVED
.....................


RODI4A
```

Data file [11] .OPCITD.DATA(PEE1D70O)

CITATION input for 'basic fuel cycle'

```
CITATION                                                        00000010
IC01FF    SLAROM                                                00000120
```

```
  600MW / 60 CM PU BURNING CORE , PU VECTOR STUDY , LOW QUALITY PU
                 CORE 7 , 165% PIN SIZE,  RODS 0% IN
001
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0
  1  1  0  1  1  0  0  1  1  0  0  1  1  1  0  0  0  0  0  0  0  0  0  0

003
  0  0  0  0  7  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
   5.0000E-6   1.0000E-6
                          1.5600E+3
004
 10 46.21720  1  4.27490  7 38.52480  1  2.29260  1  2.23650  7 38.48690
  1  4.61620  6 28.74400  1  1.24510  1  2.46280  5 21.29210  2  6.00000
  1  3.00000  4 21.10000  4 21.10000
 10 50.00000  2  7.00000  1  3.00000  2  5.00000  1  3.00000  2  6.00000
  3  9.00000  4 12.00000  4 12.00000  3  9.00000  2  6.00000  1  3.00000
  1  2.00000 14 70.00000  6 33.00000
005
 46 49 46 50 50 46 51 46 52 52 46 46 46 46 46
 41 49 41 50 50 41 51 41 52 52 41 41 41 47 46
 37 49 37 50 50 37 51 38 52 52 38 38 38 47 46
 33 49 33 50 50 33 51 34 52 52 34 34 34 47 46
  1 42  1 43 43  1 44  9 45 45  9 17 25 47 46
  2 42  2 43 43  2 44 10 45 45 10 18 26 47 46
  3 42  3 43 43  3 44 11 45 45 11 19 27 47 46
  4 42  4 43 43  4 44 12 45 45 12 20 28 47 46
  5 42  5 43 43  5 44 13 45 45 13 21 29 47 46
  6 42  6 43 43  6 44 14 45 45 14 22 30 47 46
  7 42  7 43 43  7 44 15 45 45 15 23 31 47 46
  8 42  8 43 43  8 44 16 45 45 16 24 32 47 46
 39 42 39 43 43 39 44 40 45 45 40 40 40 47 46
 35 42 35 43 43 35 44 36 45 45 36 36 36 47 46
 48 48 48 48 48 48 48 48 48 48 48 48 48 46 46
008                                                                     00000270
-70 70  0 52  2  1  1  3                                                00000280
  1                                                                     00000290
IC01F      SLAROM                                                       00000120
  2                                                                     00000290
IC02F      SLAROM                                                       00000120
  3                                                                     00000290
IC03F      SLAROM                                                       00000120
  4                                                                     00000290
IC04F      SLAROM                                                       00000120
  5                                                                     00000290
IC05F      SLAROM                                                       00000120
  6                                                                     00000290
IC06F      SLAROM                                                       00000120
  7                                                                     00000290
IC07F      SLAROM                                                       00000120
  8                                                                     00000290
IC08F      SLAROM                                                       00000120
  9                                                                     00000290
OC09F      SLAROM                                                       00000120
 10                                                                     00000290
OC10F      SLAROM                                                       00000120
 11                                                                     00000290
OC11F      SLAROM                                                       00000120
 12                                                                     00000290
OC12F      SLAROM                                                       00000120
 13                                                                     00000290
OC13F      SLAROM                                                       00000120
 14                                                                     00000290
OC14F      SLAROM                                                       00000120
 15                                                                     00000290
OC15F      SLAROM                                                       00000120
 16                                                                     00000290
OC16F      SLAROM                                                       00000120
 17                                                                     00000290
OC17F      SLAROM                                                       00000120
 18                                                                     00000290
OC18F      SLAROM                                                       00000120
 19                                                                     00000290
OC19F      SLAROM                                                       00000120
 20                                                                     00000290
OC20F      SLAROM                                                       00000120
 21                                                                     00000290
OC21F      SLAROM                                                       00000120
 22                                                                     00000290
OC22F      SLAROM                                                       00000120
 23                                                                     00000290
OC23F      SLAROM                                                       00000120
 24                                                                     00000290
OC24F      SLAROM                                                       00000120
 25                                                                     00000290
OC25F      SLAROM                                                       00000120
 26                                                                     00000290
OC26F      SLAROM                                                       00000120
 27                                                                     00000290
OC27F      SLAROM                                                       00000120
 28                                                                     00000290
OC28F      SLAROM                                                       00000120
 29                                                                     00000290
OC29F      SLAROM                                                       00000120
 30                                                                     00000290
OC30F      SLAROM                                                       00000120
 31                                                                     00000290
OC31F      SLAROM                                                       00000120
 32                                                                     00000290
OC32F      SLAROM                                                       00000120
 33                                                                     00000290
UIPLN      SLAROM                                                       00000120
 34                                                                     00000290
UOPLN      SLAROM                                                       00000120
 35                                                                     00000290
LIPLN      SLAROM                                                       00000120
 36                                                                     00000290
LOPLN      SLAROM                                                       00000120
 37                                                                     00000290
UIPLG      SLAROM                                                       00000120
 38                                                                     00000290
UOPLG      SLAROM                                                       00000120
 39                                                                     00000290
LIPLG      SLAROM                                                       00000120
 40                                                                     00000290
LOPLG      SLAROM                                                       00000120
 41                                                                     00000290
UPGAP      SLAROM                                                       00000120
```

```
 42                                                                    00000290
FOLL1      SLAROM                                                     00000120
 43                                                                    00000290
FOLL2      SLAROM                                                     00000120
 44                                                                    00000290
FOLL3      SLAROM                                                     00000120
 45                                                                    00000290
FOLL4      SLAROM                                                     00000120
 46                                                                    00000290
SHIEL      SLAROM                                                     00000120
 47                                                                    00000290
IRDSH      SLAROM                                                     00000120
 48                                                                    00000290
LSHLD      SLAROM                                                     00000120
 49                                                                    00000290
RODI1      SLAROM                                                     00000120
 50                                                                    00000290
RODI2      SLAROM                                                     00000120
 51                                                                    00000290
RODI3      SLAROM                                                     00000120
 52                                                                    00000290
RODI4      SLAROM                                                     00000120

IC01F      SLAROM                                                     00000890
023                                                                   00000300
  0  0  0  7                                                         00000910
999                                                                   00000920
                                                                      00000960
```

Data file [12] .OPDEND.DATA(GDI3PRT)

SLAROM input for 'perturbation'

```
PREP
 INNER CORE  1,C7,HPU40/45%,4*9.75M,165%,24/8ZRH/B4C,PERT,GDI3
  2  1  0  1  1  0  3 -20  0  0  0  0 70
 10703.15 1.3 0.0
 1373.15 703.15
    25     8
 0.30705  0.30160
 949 0.522699E-02 940 0.840088E-03 941 0.648861E-04 942 0.283603E-05
 951 0.319672E-05 925 0.230442E-04 926 0.208237E-05 928 0.100579E-01
   8 0.349848E-01   6 0.111864E-02
 937 0.185217E-05 939 0.193110E-05 950 0.702519E-07
 953 0.134268E-06 962 0.143732E-06 963 0.465225E-08 964 0.121468E-07
 965 0.436447E-09 948 0.452596E-06
 105 0.924847E-03
 115 0.304139E-02
 887 0.597014E-04 897 0.133347E-02 857 0.688767E-05
 817 0.448337E-04

  11 0.139463E-01  26 0.158146E-01  24 0.440852E-02  28 0.310159E-02
  42 0.351362E-03  25 0.368157E-03  40 0.171951E-02   1 0.292317E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.60865
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
IC01FF
PREP
 INNER CORE  2,C7,HPU40/45%,4*9.75M,165%,24/8ZRH/B4C,PERT,GDI3
  2  1  0  1  1  0  3   0  0  0  0  0 70
 10703.15 1.3 0.0
 1373.15 703.15
    25     8
 0.30705  0.30160
 949 0.510408E-02 940 0.853884E-03 941 0.674971E-04 942 0.313286E-05
 951 0.329624E-05 925 0.223986E-04 926 0.216956E-05 928 0.100072E-01
   8 0.349848E-01   6 0.111864E-02
 937 0.232319E-05 939 0.207934E-05 950 0.762319E-07
 953 0.151805E-06 962 0.157391E-06 963 0.532589E-08 964 0.144924E-07
 965 0.542844E-09 948 0.560082E-06
 105 0.900654E-03
 115 0.304139E-02
 887 0.766799E-04 897 0.146361E-02 857 0.743652E-05
 817 0.543780E-04

  11 0.139463E-01  26 0.158146E-01  24 0.440852E-02  28 0.310159E-02
  42 0.351362E-03  25 0.368157E-03  40 0.171951E-02   1 0.292317E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.60865
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
IC02FF
PREP

.....................

REPETETIVE DATA REMOVED
.....................

OC15FF
PREP
 OUTER CORE 16,C7,HPU40/45%,4*9.75M,165%,24/8ZRH/B4C,PERT,GDI3
  2  1  0  1  1  0  3   0  0  0  0  0 70
 10703.15 1.3 0.0
 1373.15 703.15
```

```
   25     8
 0.30705  0.26171
 949 0.518056E-02 940 0.800749E-03 941 0.631022E-04 942 0.269689E-05
 951 0.313127E-05 925 0.189842E-04 926 0.162312E-05 928 0.811942E-02
   8 0.306073E-01   6 0.976832E-03
 937 0.128360E-05 939 0.148325E-05 950 0.672017E-07
 953 0.132617E-06 962 0.136709E-06 963 0.440933E-08 964 0.119792E-07
 965 0.440346E-09 948 0.354594E-06
 105 0.821440E-03
 115 0.265585E-02
 887 0.407280E-04 897 0.118156E-02 857 0.516368E-05
 817 0.378454E-04

  11 0.146730E-01  26 0.166387E-01  24 0.463825E-02  28 0.326322E-02
  42 0.369672E-03  25 0.387342E-03  40 0.180912E-02   1 0.307549E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.56876
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
OC16FF
PREP
PLENUM ,LO Q PU,165%FUEL, UPPER INNER
  1  1  0  0  0  0  3   0  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 1.17900E-02  24 3.28650E-03  28 2.31220E-03
   42 2.61950E-04  25 2.74470E-04
UIPLNN
PREP
PLUGGED PIN, LO Q ,165%FUEL UPPER INNER
  1  1  0  0  0  0  3   0  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 2.96650E-02  24 8.26930E-03  28 5.81800E-03
   42 6.59100E-04  25 6.90610E-04
UIPLGG
PREP
ROD FOLLOWER 1
  1  1  0  0  0  0  3   0  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.99080E-02  26 5.24170E-03  24 1.46120E-03  28 1.02800E-03
   42 1.16460E-04  25 1.22020E-04
FOLL1W
PREP
UPPER AXIAL & OUTER RADIAL SHIELD
  1  1  0  0  0  0  3   0  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 4.38990E-03  26 4.50900E-02  24 1.25690E-02  28 8.84310E-03
   42 1.00180E-03  25 1.04970E-03
SHIELD
PREP
LOWER SHIELD,
  1  1  0  0  0  0  3   0  0  0  0  0 70
 703.15 0.0 0.0
  9
 1.0
   11 6.36540E-03  26 1.77540E-02  24 4.94900E-03  28 3.48200E-03
   42 3.94460E-04  25 4.13320E-04   6 9.24600E-03 105 7.89610E-03
  115 2.90880E-02
LSHLDD
PREP
ABSORBER ROD 1,  HETEROGENEOUS CELL MODEL   WITHIN 9.7 S/A FUEL
  6  1  0  1  1  0  3   0  0  0  0  0 70
 703.15 1.3 0.0
  3  1  5  1  5  30
 4.7901  0.1137  0.9751  2.1419  0.3937  18.8519
    6 2.47080E-02 105 9.15890E-02 115 7.24350E-03 /
   11 2.19495E-09 /
                  26 5.63630E-02  24 1.57110E-02  28 1.10540E-02
   42 1.25230E-03  25 1.31210E-03 /
   11 2.19495E-02 /
                  26 5.63630E-02  24 1.57110E-02  28 1.10540E-02
   42 1.25230E-03  25 1.31210E-03 /
  949 6.49311E-04 940 8.17696E-04 941 1.68546E-04 942 3.13512E-04
  951 1.94612E-05 925 7.78987E-06 926 3.61466E-07 928 2.99340E-03
    8 1.03332E-02  11 1.18383E-02  26 1.07946E-02  24 3.00913E-03
   28 2.11706E-03  42 2.39830E-04  25 2.51294E-04
   40 6.79872E-04
  937 3.26805E-07 939 6.64538E-07 950 4.94608E-07 953 1.17133E-05
  962 1.13309E-06 963 4.51328E-08 964 1.29052E-06 965 4.89657E-08
  948 6.45035E-05
    1 1.15578E-03
  887 1.02518E-05 897 8.98626E-05 857 1.21029E-06
  817 6.73348E-05 /

PATH
 TITLE CARD  HETEROGENEOUS ROD
 70  6  2  1  1  0  0
 3  6  6  0  6  0  0  0  0  0  0  8 10  0  0 15  0
 1  2  3  4  5  6
 0.0  4.7901  4.9038  5.7652  7.9071  8.3008  27.1527
PIJF
 37  0  5  3  0  1  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
 2  2  1  1  0
 1  5  1  5
RODI1A
PREP
 INNER CORE  1,C7,HPU40/45%,4*9.75M,165%,24/8ZRH/B4C,PERT,GDI3 NA VOID
  2  1  0  1  1  0  3 -20  0  0  0  0 70
 10703.15 1.3 0.0
```

```
1373.15 703.15
   25     8
0.30705  0.30160
949 0.522699E-02 940 0.840088E-03 941 0.648861E-04 942 0.283603E-05
951 0.319672E-05 925 0.230442E-04 926 0.208237E-05 928 0.100579E-01
  8 0.349848E-01   6 0.111864E-02
937 0.185217E-05 939 0.193110E-05 950 0.702519E-07
953 0.134268E-06 962 0.143732E-06 963 0.465225E-08 964 0.121468E-07
965 0.436447E-09 948 0.452596E-06
105 0.924847E-03
115 0.304139E-02
887 0.597014E-04 897 0.133347E-02 857 0.688767E-05
817 0.448337E-04

 11 0.000000E-00  26 0.158146E-01  24 0.440852E-02  28 0.310159E-02
 42 0.351362E-03  25 0.368157E-03  40 0.171951E-02   1 0.292317E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.60865
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
IC01VV
PREP

.....................

REPETETIVE DATA REMOVED
.....................

OC15VV
PREP
 OUTER CORE 16,C7,HPU40/45%,4*9.75M,165%,24/8ZRH/B4C,PERT,GDI3
  2  1  0  1  1  0  3   0  0  0  0  0 70
 10703.15 1.3 0.0
 1373.15 703.15
    25     8
 0.30705  0.26171
 949 0.518056E-02 940 0.800749E-03 941 0.631022E-04 942 0.269689E-05
 951 0.313127E-05 925 0.189842E-04 926 0.162312E-05 928 0.811942E-02
   8 0.306073E-01   6 0.976832E-03
 937 0.128360E-05 939 0.148325E-05 950 0.672017E-07
 953 0.132617E-06 962 0.136709E-06 963 0.440933E-08 964 0.119792E-07
 965 0.440346E-09 948 0.354594E-06
 105 0.821440E-03
 115 0.265585E-02
 887 0.407280E-04 897 0.118156E-02 857 0.516368E-05
 817 0.378454E-04

  11 0.000000E-00  26 0.166387E-01  24 0.463825E-02  28 0.326322E-02
  42 0.369672E-03  25 0.387342E-03  40 0.180912E-02   1 0.307549E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.56876
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
OC16VV
PREP
 INNER CORE  1,C7,HPU40/45%,4*9.75M,165%,24/8ZRH/B4C,PERT,GDI3 DOPPLER
  2  1  0  1  1  0  3 -20  0  0  0  0 70
 10703.15 1.3 0.0
 1873.15 703.15
    25     8
 0.30705  0.30160
 949 0.522699E-02 940 0.840088E-03 941 0.648861E-04 942 0.283603E-05
 951 0.319672E-05 925 0.230442E-04 926 0.208237E-05 928 0.100579E-01
   8 0.349848E-01   6 0.111864E-02
 937 0.185217E-05 939 0.193110E-05 950 0.702519E-07
 953 0.134268E-06 962 0.143732E-06 963 0.465225E-08 964 0.121468E-07
 965 0.436447E-09 948 0.452596E-06
 105 0.924847E-03
 115 0.304139E-02
 887 0.597014E-04 897 0.133347E-02 857 0.688767E-05
 817 0.448337E-04

  11 0.139463E-01  26 0.158146E-01  24 0.440852E-02  28 0.310159E-02
  42 0.351362E-03  25 0.368157E-03  40 0.171951E-02   1 0.292317E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.60865
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
IC01DD
PREP

.....................

REPETETIVE DATA REMOVED
.....................

OC15DD
PREP
 OUTER CORE 16,C7,HPU40/45%,4*9.75M,165%,24/8ZRH/B4C,PERT,GDI3
  2  1  0  1  1  0  3   0  0  0  0  0 70
 10703.15 1.3 0.0
```

```
1873.15 703.15
   25     8
0.30705  0.26171
949 0.518056E-02 940 0.800749E-03 941 0.631022E-04 942 0.269689E-05
951 0.313127E-05 925 0.189842E-04 926 0.162312E-05 928 0.811942E-02
  8 0.306073E-01   6 0.976832E-03
937 0.128360E-05 939 0.148325E-05 950 0.672017E-07
953 0.132617E-06 962 0.136709E-06 963 0.440933E-08 964 0.119792E-07
965 0.440346E-09 948 0.354594E-06
105 0.821440E-03
115 0.265585E-02
887 0.407280E-04 897 0.118156E-02 857 0.516368E-05
817 0.378454E-04

 11 0.146730E-01  26 0.166387E-01  24 0.463825E-02  28 0.326322E-02
 42 0.369672E-03  25 0.387342E-03  40 0.180912E-02   1 0.307549E-02

PATH
 HETEROGENEOUS 2 TEMPERATURE MODEL
 70  2  2  1  0  0  0
  3  2  2  0  2  0  0  0  4  0  6  180  0  0  360  0
  1  2
 0.0  0.30705  0.56876
PIJF
 37  0  5  3  0  0  0  0
  0  0  0.  0.  0.  0.
  0
EDIT
  2  2  1  0  0
OC16DD
```


Data file [13] .OPCITD.DATA(PIJ3P70N)

CITATION input, 70 groups, normal, for 'perturbation'

```
CITATION                                                                  00000010
IC01FF    SLAROM                                                          00000120
  600MW / 60 CM PU BURNING CORE , PU VECTOR STUDY , LOW QUALITY PU
    PERTURBATION 70 GROUP NORMAL,  CORE 7 , 165% PIN SIZE,  RODS 0% IN
001
  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
  1  0  0  1  1  0  0  1  1  2  0  0  0  1  0  0  0  0  0  0  0  0  0  0


003
  0  0  0  0  7  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
   5.0000E-6   1.0000E-6
                           1.5600E+3
004
 10 46.21720  1  4.27490  7 38.52480  1  2.29260  1  2.23650  7 38.48690
  1  4.61620  6 28.74400  1  1.24510  1  2.46280  5 21.29210  2  6.00000
  1  3.00000  4 21.10000  4 21.10000
 10 50.00000  2  7.00000  1  3.00000  2  5.00000  1  3.00000  2  6.00000
  3  9.00000  4 12.00000  4 12.00000  3  9.00000  2  6.00000  1  3.00000
  1  2.00000 14 70.00000  6 33.00000
005
 20 22 20 22 22 20 22 20 22 22 20 20 20 20 20
 19 22 19 22 22 19 22 19 22 22 19 19 19 20 20
 18 22 18 22 22 18 22 18 22 22 18 18 18 20 20
 17 22 17 22 22 17 22 17 22 22 17 17 17 20 20
  1 19  1 19 19  1 19  9 19 19  9  9  9 20 20
  2 19  2 19 19  2 19 10 19 19 10 10 10 20 20
  3 19  3 19 19  3 19 11 19 19 11 11 11 20 20
  4 19  4 19 19  4 19 12 19 19 12 12 12 20 20
  5 19  5 19 19  5 19 13 19 19 13 13 13 20 20
  6 19  6 19 19  6 19 14 19 19 14 14 14 20 20
  7 19  7 19 19  7 19 15 19 19 15 15 15 20 20
  8 19  8 19 19  8 19 16 19 19 16 16 16 20 20
 18 19 18 19 19 18 19 18 19 19 18 18 18 20 20
 17 19 17 19 19 17 19 17 19 19 17 17 17 20 20
 21 21 21 21 21 21 21 21 21 21 21 21 21 20 20
008                                                                       00000270
-70 70  0 22  2  1  1  3                                                  00000280
  1                                                                       00000290
IC01FF    SLAROM                                                          00000120
  2                                                                       00000290
IC02FF    SLAROM                                                          00000120
  3                                                                       00000290
IC03FF    SLAROM                                                          00000120
  4                                                                       00000290
IC04FF    SLAROM                                                          00000120
  5                                                                       00000290
IC05FF    SLAROM                                                          00000120
  6                                                                       00000290
IC06FF    SLAROM                                                          00000120
  7                                                                       00000290
IC07FF    SLAROM                                                          00000120
  8                                                                       00000290
IC08FF    SLAROM                                                          00000120
  9                                                                       00000290
OC09FF    SLAROM                                                          00000120
 10                                                                       00000290
OC10FF    SLAROM                                                          00000120
 11                                                                       00000290
OC11FF    SLAROM                                                          00000120
 12                                                                       00000290
OC12FF    SLAROM                                                          00000120
 13                                                                       00000290
OC13FF    SLAROM                                                          00000120
 14                                                                       00000290
OC14FF    SLAROM                                                          00000120
 15                                                                       00000290
OC15FF    SLAROM                                                          00000120
 16                                                                       00000290
OC16FF    SLAROM                                                          00000120
 17                                                                       00000290
UIPLNN    SLAROM                                                          00000120
 18                                                                       00000290
UIPLGG    SLAROM                                                          00000120
 19                                                                       00000290
FOLL1W    SLAROM                                                          00000120
 20                                                                       00000290
```

```
SHIELD    SLAROM                                                    00000120
 21                                                                 00000290
LSHLDD    SLAROM                                                    00000120
 22                                                                 00000290
RODI1A    SLAROM                                                    00000120
                                                                    00000890
IC01FF    SLAROM                                                    00000300
023                                                                 00000910
  0  0  0  7                                                       00000920
040                                                                 00000910
  0        0  0  0    2  0  0  0  0  0       0                     00000920
999                                                                 00000960
```

Data file [14] .OPEDID.DATA(PIJ3PF)

flux extract JOINT input, normal, for 'perturbation'

```
CITATIONPOST

0
 70  22  1  0
IC01FF                                                              00000120
IC02FF                                                              00000120
IC03FF                                                              00000120
IC04FF                                                              00000120
IC05FF                                                              00000120
IC06FF                                                              00000120
IC07FF                                                              00000120
IC08FF                                                              00000120
OC09FF                                                              00000120
OC10FF                                                              00000120
OC11FF                                                              00000120
OC12FF                                                              00000120
OC13FF                                                              00000120
OC14FF                                                              00000120
OC15FF                                                              00000120
OC16FF                                                              00000120
UIPLNN                                                              00000120
UIPLGG                                                              00000120
FOLL1W                                                              00000120
SHIELD                                                              00000120
LSHLDD                                                              00000120
RODI1A                                                              00000120
```


Data file [15] .OPEDID.DATA(PIJ3PC)

condensation JOINT input, 18 groups, for 'perturbation'

```
CITATIONPOST                                                        00000010
                                                                    00000020
1                                                                   00000030
18                                                                  00000040
  2  4  6  8 10 13 16 19 22 25 28 31 34 37 40 43 46 70              00000050
PDSIN   IC01FF  SLAR  0  1                                          00000060
PDSOUT  IC01FF  SLAR                                                00000070
USERPDS IC01FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   IC02FF  SLAR  0  1                                          00000060
PDSOUT  IC02FF  SLAR                                                00000070
USERPDS IC02FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   IC03FF  SLAR  0  1                                          00000060
PDSOUT  IC03FF  SLAR                                                00000070
USERPDS IC03FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   IC04FF  SLAR  0  1                                          00000060
PDSOUT  IC04FF  SLAR                                                00000070
USERPDS IC04FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   IC05FF  SLAR  0  1                                          00000060
PDSOUT  IC05FF  SLAR                                                00000070
USERPDS IC05FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   IC06FF  SLAR  0  1                                          00000060
PDSOUT  IC06FF  SLAR                                                00000070
USERPDS IC06FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   IC07FF  SLAR  0  1                                          00000060
PDSOUT  IC07FF  SLAR                                                00000070
USERPDS IC07FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   IC08FF  SLAR  0  1                                          00000060
PDSOUT  IC08FF  SLAR                                                00000070
USERPDS IC08FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   OC09FF  SLAR  0  1                                          00000060
PDSOUT  OC09FF  SLAR                                                00000070
USERPDS OC09FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   OC10FF  SLAR  0  1                                          00000060
PDSOUT  OC10FF  SLAR                                                00000070
USERPDS OC10FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   OC11FF  SLAR  0  1                                          00000060
PDSOUT  OC11FF  SLAR                                                00000070
USERPDS OC11FF  CITA                                                00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                00000020
PDSIN   OC12FF  SLAR  0  1                                          00000060
PDSOUT  OC12FF  SLAR                                                00000070
```

```
USERPDS OC12FF  CITA                                                    00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   OC13FF  SLAR  0  1                                              00000060
PDSOUT  OC13FF  SLAR                                                    00000070
USERPDS OC13FF  CITA                                                    00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   OC14FF  SLAR  0  1                                              00000060
PDSOUT  OC14FF  SLAR                                                    00000070
USERPDS OC14FF  CITA                                                    00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   OC15FF  SLAR  0  1                                              00000060
PDSOUT  OC15FF  SLAR                                                    00000070
USERPDS OC15FF  CITA                                                    00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   OC16FF  SLAR  0  1                                              00000060
PDSOUT  OC16FF  SLAR                                                    00000070
USERPDS OC16FF  CITA                                                    00000080
 INNER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   UIPLNN  SLAR  0  1                                              00000060
PDSOUT  UIPLNN  SLAR                                                    00000070
USERPDS UIPLNN  CITA                                                    00000080
 OUTER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   UIPLGG  SLAR  0  1                                              00000060
PDSOUT  UIPLGG  SLAR                                                    00000070
USERPDS UIPLGG  CITA                                                    00000080
 OUTER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   FOLL1W  SLAR  0  1                                              00000060
PDSOUT  FOLL1W  SLAR                                                    00000070
USERPDS FOLL1W  CITA                                                    00000080
 OUTER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   SHIELD  SLAR  0  1                                              00000060
PDSOUT  SHIELD  SLAR                                                    00000070
USERPDS SHIELD  CITA                                                    00000080
 OUTER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   LSHLDD  SLAR  0  1                                              00000060
PDSOUT  LSHLDD  SLAR                                                    00000070
USERPDS LSHLDD  CITA                                                    00000080
 OUTER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
PDSIN   RODI1A  SLAR  0  1                                              00000060
PDSOUT  RODI1A  SLAR                                                    00000070
USERPDS RODI1A  CITA                                                    00000080
 OUTER-CORE 182*4DAY,HI Q PU , 40% T.D.  HAA ITER. 1                    00000020
```

Data file [16] .OPCITD.DATA(PIJ3PV70)

CITATION input, void, 70 groups, for 'perturbation'

```
CITATION                                                                00000010
IC01VV    SLAROM                                                        00000120
  600MW / 60 CM PU BURNING CORE , PU VECTOR STUDY , LOW QUALITY PU
    PERTURBATION 70 GROUP  VOID ,  CORE 7 , 165% PIN SIZE,  RODS 0% IN
001
  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0
    1  0  0  1  1  0  0  1  1  2  0  0  0  1  0  0  0  0  0  0  0  0  0  0
003
  0  0  0  0  7  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
     5.0000E-6   1.0000E-6
                                    1.5600E+3
004
 10 46.21720  1  4.27490  7 38.52480  1  2.29260  1  2.23650  7 38.48690
  1  4.61620  6 28.74400  1  1.24510  1  2.46280  5 21.29210  2  6.00000
  1  3.00000  4 21.10000  4 21.10000
 10 50.00000  2  7.00000  1  3.00000  2  5.00000  1  3.00000  2  6.00000
  3  9.00000  4 12.00000  4 12.00000  3  9.00000  2  6.00000  1  3.00000
  1  2.00000 14 70.00000  6 33.00000
005
 20 22 20 22 22 20 22 20 22 22 20 20 20 20 20
 19 22 19 22 22 19 22 19 22 22 19 19 19 20 20
 18 22 18 22 22 18 22 18 22 22 18 18 18 20 20
 17 22 17 22 22 17 22 17 22 22 17 17 17 20 20
  1 19  1 19 19  1 19  9 19 19  9  9  9 20 20
  2 19  2 19 19  2 19 10 19 19 10 10 10 20 20
  3 19  3 19 19  3 19 11 19 19 11 11 11 20 20
  4 19  4 19 19  4 19 12 19 19 12 12 12 20 20
  5 19  5 19 19  5 19 13 19 19 13 13 13 20 20
  6 19  6 19 19  6 19 14 19 19 14 14 14 20 20
  7 19  7 19 19  7 19 15 19 19 15 15 15 20 20
  8 19  8 19 19  8 19 16 19 19 16 16 16 20 20
 18 19 18 19 19 18 19 18 19 19 18 18 18 20 20
 17 19 17 19 19 17 19 17 19 19 17 17 17 20 20
 21 21 21 21 21 21 21 21 21 21 21 21 21 20 20
008                                                                     00000270
-70 70  0 22  2  1  1  3                                                00000280
  1                                                                     00000290
IC01VV    SLAROM                                                        00000120
  2                                                                     00000290
IC02VV    SLAROM                                                        00000120
  3                                                                     00000290
IC03VV    SLAROM                                                        00000120
  4                                                                     00000290
IC04VV    SLAROM                                                        00000120
  5                                                                     00000290
IC05VV    SLAROM                                                        00000120
  6                                                                     00000290
IC06VV    SLAROM                                                        00000120
  7                                                                     00000290
IC07VV    SLAROM                                                        00000120
  8                                                                     00000290
IC08VV    SLAROM                                                        00000120
  9                                                                     00000290
OC09VV    SLAROM                                                        00000120
 10                                                                     00000290
OC10VV    SLAROM                                                        00000120
 11                                                                     00000290
OC11VV    SLAROM                                                        00000120
 12                                                                     00000290
OC12VV    SLAROM                                                        00000120
 13                                                                     00000290
OC13VV    SLAROM                                                        00000120
 14                                                                     00000290
```

```
OC14VV    SLAROM                                                    00000120
 15                                                                 00000290
OC15VV    SLAROM                                                    00000120
 16                                                                 00000290
OC16VV    SLAROM                                                    00000120
 17                                                                 00000290
UIPLNN    SLAROM                                                    00000120
 18                                                                 00000290
UIPLGG    SLAROM                                                    00000120
 19                                                                 00000290
FOLL1W    SLAROM                                                    00000120
 20                                                                 00000290
SHIELD    SLAROM                                                    00000120
 21                                                                 00000290
LSHLDD    SLAROM                                                    00000120
 22                                                                 00000290
RODI1A    SLAROM                                                    00000120
                                                                    00000890
IC01VV    SLAROM                                                    00000300
999                                                                 00000960
```

Data file [17] .OPCITD.DATA(PIJ3PADJ)

CITATION input, direct + adjoint, normal, 18 groups, 'perturbations'

```
CITATION                                                            00000010
IC01FF    SLAROM                                                    00000120
  600MW / 60 CM PU BURNING CORE , PU VECTOR STUDY , LOW QUALITY PU
    PERTURBATION 18 GROUP NORMAL,  CORE 7 , 165% PIN SIZE,  RODS 0% IN
001
  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
  1  0  0  1  1  0  0  1  1  2  0  0  0  0  0  0  0  0  0  0  0  0  0  0


003
  0  0  0  0  7  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
   5.0000E-6   1.0000E-6
                                1.5600E+3
004
 10 46.21720  1  4.27490  7 38.52480  1  2.29260  1  2.23650  7 38.48690
  1  4.61620  6 28.74400  1  1.24510  1  2.46280  5 21.29210  2  6.00000
  1  3.00000  4 21.10000  4 21.10000
 10 50.00000  2  7.00000  1  3.00000  2  5.00000  1  3.00000  2  6.00000
  3  9.00000  4 12.00000  4 12.00000  3  9.00000  2  6.00000  1  3.00000
  1  2.00000 14 70.00000  6 33.00000
005
 20 22 20 22 22 20 22 20 22 22 20 20 20 20 20
 19 22 19 22 22 19 22 19 22 22 19 19 19 20 20
 18 22 18 22 22 18 22 18 22 22 18 18 18 20 20
 17 22 17 22 22 17 22 17 22 22 17 17 17 20 20
  1 19  1 19 19  1 19  9 19 19  9  9  9 20 20
  2 19  2 19 19  2 19 10 19 19 10 10 10 20 20
  3 19  3 19 19  3 19 11 19 19 11 11 11 20 20
  4 19  4 19 19  4 19 12 19 19 12 12 12 20 20
  5 19  5 19 19  5 19 13 19 19 13 13 13 20 20
  6 19  6 19 19  6 19 14 19 19 14 14 14 20 20
  7 19  7 19 19  7 19 15 19 19 15 15 15 20 20
  8 19  8 19 19  8 19 16 19 19 16 16 16 20 20
 18 19 18 19 19 18 19 18 19 19 18 18 18 20 20
 17 19 17 19 19 17 19 17 19 19 17 17 17 20 20
 21 21 21 21 21 21 21 21 21 21 21 21 21 20 20
008                                                                 00000270
-18 18  0 22  2  1  1  3                                            00000280
  1                                                                 00000290
IC01FF    SLAROM                                                    00000120
  2                                                                 00000290
IC02FF    SLAROM                                                    00000120
  3                                                                 00000290
IC03FF    SLAROM                                                    00000120
  4                                                                 00000290
IC04FF    SLAROM                                                    00000120
  5                                                                 00000290
IC05FF    SLAROM                                                    00000120
  6                                                                 00000290
IC06FF    SLAROM                                                    00000120
  7                                                                 00000290
IC07FF    SLAROM                                                    00000120
  8                                                                 00000290
IC08FF    SLAROM                                                    00000120
  9                                                                 00000290
OC09FF    SLAROM                                                    00000120
 10                                                                 00000290
OC10FF    SLAROM                                                    00000120
 11                                                                 00000290
OC11FF    SLAROM                                                    00000120
 12                                                                 00000290
OC12FF    SLAROM                                                    00000120
 13                                                                 00000290
OC13FF    SLAROM                                                    00000120
 14                                                                 00000290
OC14FF    SLAROM                                                    00000120
 15                                                                 00000290
OC15FF    SLAROM                                                    00000120
 16                                                                 00000290
OC16FF    SLAROM                                                    00000120
 17                                                                 00000290
UIPLNN    SLAROM                                                    00000120
 18                                                                 00000290
UIPLGG    SLAROM                                                    00000120
 19                                                                 00000290
FOLL1W    SLAROM                                                    00000120
 20                                                                 00000290
SHIELD    SLAROM                                                    00000120
 21                                                                 00000290
LSHLDD    SLAROM                                                    00000120
 22                                                                 00000290
RODI1A    SLAROM                                                    00000120
                                                                    00000890
IC01FF    SLAROM                                                    00000300
040                                                                 00000910
  0       0  0  0     2  0  0  0  0        0                        00000920
999                                                                 00000960
```

Data file [18] .OPCITD.DATA(PIJ3P70D)

CITATION input, Doppler, 70 group, for 'perturbation'

```
CITATION                                                                  00000010
IC01FF    SLAROM                                                          00000120
  600MW / 60 CM PU BURNING CORE , PU VECTOR STUDY , LOW QUALITY PU
    PERTURBATION 70 GROUP DOPPLER,  CORE 7 , 165% PIN SIZE,  RODS 0% IN
001
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0
  1  0  0  0  1  0  0  1  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0


003
  0  0  0  0  7  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
   5.0000E-6   1.0000E-6
                          1.5600E+3
004
 10 46.21720  1  4.27490  7 38.52480  1  2.29260  1  2.23650  7 38.48690
  1  4.61620  6 28.74400  1  1.24510  1  2.46280  5 21.29210  2  6.00000
  1  3.00000  4 21.10000  4 21.10000
 10 50.00000  2  7.00000  1  3.00000  2  5.00000  1  3.00000  2  6.00000
  3  9.00000  4 12.00000  4 12.00000  3  9.00000  2  6.00000  1  3.00000
  1  2.00000 14 70.00000  6 33.00000
005
 20 22 20 22 22 20 22 20 22 22 20 20 20 20 20
 19 22 19 22 22 19 22 19 22 22 19 19 19 20 20
 18 22 18 22 22 18 22 18 22 22 18 18 18 20 20
 17 22 17 22 22 17 22 17 22 22 17 17 17 20 20
  1 19  1 19 19  1 19  9 19 19  9  9  9 20 20
  2 19  2 19 19  2 19 10 19 19 10 10 10 20 20
  3 19  3 19 19  3 19 11 19 19 11 11 11 20 20
  4 19  4 19 19  4 19 12 19 19 12 12 12 20 20
  5 19  5 19 19  5 19 13 19 19 13 13 13 20 20
  6 19  6 19 19  6 19 14 19 19 14 14 14 20 20
  7 19  7 19 19  7 19 15 19 19 15 15 15 20 20
  8 19  8 19 19  8 19 16 19 19 16 16 16 20 20
 18 19 18 19 19 18 19 18 19 19 18 18 18 20 20
 17 19 17 19 19 17 19 17 19 19 17 17 17 20 20
 21 21 21 21 21 21 21 21 21 21 21 21 21 20 20
008                                                                       00000270
-70 70  0 22  2  1  1  3                                                  00000280
  1                                                                       00000290
IC01DD    SLAROM                                                          00000120
  2                                                                       00000290
IC02DD    SLAROM                                                          00000120
  3                                                                       00000290
IC03DD    SLAROM                                                          00000120
  4                                                                       00000290
IC04DD    SLAROM                                                          00000120
  5                                                                       00000290
IC05DD    SLAROM                                                          00000120
  6                                                                       00000290
IC06DD    SLAROM                                                          00000120
  7                                                                       00000290
IC07DD    SLAROM                                                          00000120
  8                                                                       00000290
IC08DD    SLAROM                                                          00000120
  9                                                                       00000290
OC09DD    SLAROM                                                          00000120
 10                                                                       00000290
OC10DD    SLAROM                                                          00000120
 11                                                                       00000290
OC11DD    SLAROM                                                          00000120
 12                                                                       00000290
OC12DD    SLAROM                                                          00000120
 13                                                                       00000290
OC13DD    SLAROM                                                          00000120
 14                                                                       00000290
OC14DD    SLAROM                                                          00000120
 15                                                                       00000290
OC15DD    SLAROM                                                          00000120
 16                                                                       00000290
OC16DD    SLAROM                                                          00000120
 17                                                                       00000290
UIPLNN    SLAROM                                                          00000120
 18                                                                       00000290
UIPLGG    SLAROM                                                          00000120
 19                                                                       00000290
FOLL1W    SLAROM                                                          00000120
 20                                                                       00000290
SHIELD    SLAROM                                                          00000120
 21                                                                       00000290
LSHLDD    SLAROM                                                          00000120
 22                                                                       00000290
RODI1A    SLAROM                                                          00000120
                                                                          00000890
IC01FF    SLAROM                                                          00000300
023                                                                       00000910
  0  0  0  7                                                             00000920
999                                                                       00000960
```

Data file [19] .OPEDID.DATA(PIJ3PNL)

PERKY input, neutron lifetime, for 'perturbation'

```
PERKY                                                                     00000010
IC01FF    SLAROM                                                          00000120
   70 GROUP          NEUTRON  LIFETIME
001
  1 70    22  1  0  0  0  1
003
  1  0  0
 22 22  0  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
 21 22
IC01FF    SLAROM                                                          00000270
 70 30  0  2  0  0  1  1  1                                               00000280
IC01FF    SLAROM                                                          00000120
```

```
IC02FF    SLAROM                                                        00000120
IC03FF    SLAROM                                                        00000120
IC04FF    SLAROM                                                        00000120
IC05FF    SLAROM                                                        00000120
IC06FF    SLAROM                                                        00000120
IC07FF    SLAROM                                                        00000120
IC08FF    SLAROM                                                        00000120
OC09FF    SLAROM                                                        00000120
OC10FF    SLAROM                                                        00000120
OC11FF    SLAROM                                                        00000120
OC12FF    SLAROM                                                        00000120
OC13FF    SLAROM                                                        00000120
OC14FF    SLAROM                                                        00000120
OC15FF    SLAROM                                                        00000120
OC16FF    SLAROM                                                        00000120
UIPLNN    SLAROM                                                        00000120
UIPLGG    SLAROM                                                        00000120
FOLL1W    SLAROM                                                        00000120
SHIELD    SLAROM                                                        00000120
LSHLDD    SLAROM                                                        00000120
RODI1A    SLAROM                                                        00000120
004                                                                     00000910
  2                                                                     00000920
006                                                                     00000960
 0.00000E+00 0.25000E+00 0.50000E+00 0.75000E+00 1.00000E+00 1.25000E+0000000920
 1.50000E+00 1.75000E+00 2.00000E+00 2.25000E+00 2.50000E+00 2.75000E+0000000920
 3.00000E+00 3.25000E+00 3.50000E+00 3.75000E+00 4.00000E+00 4.25000E+0000000920
 4.50000E+00 4.75000E+00 5.00000E+00 5.25000E+00 5.50000E+00 5.75000E+0000000920
 6.00000E+00 6.25000E+00 6.50000E+00 6.75000E+00 7.00000E+00 7.25000E+0000000920
 7.50000E+00 7.75000E+00 8.00000E+00 8.25000E+00 8.50000E+00 8.75000E+0000000920
 9.00000E+00 9.25000E+00 9.50000E+00 9.75000E+00 1.00000E+01 1.02500E+0100000920
 1.05000E+01 1.07500E+01 1.10000E+01 1.12500E+01 1.15000E+01 1.17500E+0100000920
 1.20000E+01 1.22500E+01 1.25000E+01 1.27500E+01 1.30000E+01 1.32500E+0100000920
 1.35000E+01 1.37500E+01 1.40000E+01 1.42500E+01 1.45000E+01 1.47500E+0100000920
 1.50000E+01 1.52500E+01 1.55000E+01 1.57500E+01 1.60000E+01 1.62500E+0100000920
 1.65000E+01 1.67500E+01 1.70000E+01 2.76500E+01                        00000920
999                                                                     00000960
                                                                        00000960
```

Data file [20] .OPEDID.DATA(PIJ3PDNX)

PERKY input, delayed neutron fraction, for 'perturbation'

```
PERKY                                                                   00000010
IC01FF    SLAROM                                                        00000120
    18 GROUP DELAYED NEUTRON FRACTION
001
  1 18    22  1  0  0  0  1
002
  1  0  0
 16 16  0  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
  1  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  2  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  3  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  4  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  5  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  6  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  7  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  8  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  9  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
 10  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
 11  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
 12  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
 13  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
 14  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
 15  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
 16  8
IC01FF    SLAROM                                                        00000270
 949 940 941 942 925 928 948 951
  1  1  2  2  3  3  4  4  5  5  6  6  7  7  8  8  9  9 10 10 11 11 12 12
 13 13 14 14 15 15 16 16 17    18    19    20    21    22
003
  1  0  0
 22 22  0  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
 21 22
IC01FF    SLAROM                                                        00000270
 18 18  0  2  0  0  1  1  1                                            00000280
IC01FF    SLAROM                                                        00000120
IC02FF    SLAROM                                                        00000120
IC03FF    SLAROM                                                        00000120
IC04FF    SLAROM                                                        00000120
IC05FF    SLAROM                                                        00000120
```

```
IC06FF    SLAROM                                                        00000120
IC07FF    SLAROM                                                        00000120
IC08FF    SLAROM                                                        00000120
OC09FF    SLAROM                                                        00000120
OC10FF    SLAROM                                                        00000120
OC11FF    SLAROM                                                        00000120
OC12FF    SLAROM                                                        00000120
OC13FF    SLAROM                                                        00000120
OC14FF    SLAROM                                                        00000120
OC15FF    SLAROM                                                        00000120
OC16FF    SLAROM                                                        00000120
UIPLNN    SLAROM                                                        00000120
UIPLGG    SLAROM                                                        00000120
FOLL1W    SLAROM                                                        00000120
SHIELD    SLAROM                                                        00000120
LSHLDD    SLAROM                                                        00000120
RODI1A    SLAROM                                                        00000120
004                                                                     00000910
  1                                                                     00000920
005                                                                     00000960
   18     1     8   949   940   941   942   925   928   948   951      00000920
 18                                                                     00000960
949  1                                                                 00000960
 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-0300000960
 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-0300000960
 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-03 6.30000E-0300000960
 0.0         0.0         0.0         0.0184      0.1021      0.3570     00000960
 0.3342      0.1692      0.0191      0.0         0.0         0.0        00000960
 0.0         0.0         0.0         0.0         0.0         0.0        00000960
940  1                                                                 00000960
 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-0300000960
 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-0300000960
 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-03 9.50000E-0300000960
 0.0         0.0         0.0         0.0184      0.1021      0.3570     00000960
 0.3342      0.1692      0.0191      0.0         0.0         0.0        00000960
 0.0         0.0         0.0         0.0         0.0         0.0        00000960
941  1                                                                 00000960
 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-0200000960
 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-0200000960
 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-02 1.52000E-0200000960
 0.0         0.0         0.0         0.0184      0.1021      0.3570     00000960
 0.3342      0.1692      0.0191      0.0         0.0         0.0        00000960
 0.0         0.0         0.0         0.0         0.0         0.0        00000960
942  1                                                                 00000960
 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-0200000960
 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-0200000960
 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-02 2.21000E-0200000960
 0.0         0.0         0.0         0.0184      0.1021      0.3570     00000960
 0.3342      0.1692      0.0191      0.0         0.0         0.0        00000960
 0.0         0.0         0.0         0.0         0.0         0.0        00000960
948  1                                                                 00000960
 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-0300000960
 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-0300000960
 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-03 7.90000E-0300000960
 0.0         0.0         0.0         0.0184      0.1021      0.3570     00000960
 0.3342      0.1692      0.0191      0.0         0.0         0.0        00000960
 0.0         0.0         0.0         0.0         0.0         0.0        00000960
925  1                                                                 00000960
 1.67000E-02 1.67000E-02 1.67000E-02 1.67000E-02 1.67000E-02 1.67000E-0200000960
 1.67000E-02 1.67000E-02 1.67000E-02 1.67000E-02 1.67000E-02 1.67000E-0200000960
 0.0         0.0         0.0         0.0201      0.1033      0.3571     00000960
 0.3273      0.1763      0.0159      0.0         0.0         0.0        00000960
 0.0         0.0         0.0         0.0         0.0         0.0        00000960
928  1                                                                 00000960
 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-0200000960
 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-0200000960
 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-02 4.39000E-0200000960
 0.0         0.0         0.0         0.0205      0.0952      0.3506     00000960
 0.3275      0.1900      0.0162      0.0         0.0         0.0        00000960
 0.0         0.0         0.0         0.0         0.0         0.0        00000960
951  1                                                                 00000960
 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-0300000960
 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-0300000960
 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-03 5.10000E-0300000960
 0.0         0.0         0.0         0.0184      0.1021      0.3570     00000960
 0.3342      0.1692      0.0191      0.0         0.0         0.0        00000960
 0.0         0.0         0.0         0.0         0.0         0.0        00000960
999                                                                     00000960
                                                                        00000960
```

Data file [21] .OPEDID.DATA(PIJ3PEV)

PERKY input, Na void, for 'perturbation'

```
PERKY                                                                   00000010
IC01FF    SLAROM                                                        00000120
                70 GROUP NA VOID PERTURBATION, EXACT
001
  1 70    38  1  1  0  0  1
003
  1  0  0
 38 38  0  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38
IC01FF    SLAROM                                                        00000270
 70 30  0  2  0  0  1  1  1                                            00000280
IC01FF    SLAROM                                                        00000120
IC02FF    SLAROM                                                        00000120
IC03FF    SLAROM                                                        00000120
IC04FF    SLAROM                                                        00000120
IC05FF    SLAROM                                                        00000120
IC06FF    SLAROM                                                        00000120
IC07FF    SLAROM                                                        00000120
IC08FF    SLAROM                                                        00000120
OC09FF    SLAROM                                                        00000120
OC10FF    SLAROM                                                        00000120
OC11FF    SLAROM                                                        00000120
OC12FF    SLAROM                                                        00000120
OC13FF    SLAROM                                                        00000120
OC14FF    SLAROM                                                        00000120
OC15FF    SLAROM                                                        00000120
OC16FF    SLAROM                                                        00000120
UIPLNN    SLAROM                                                        00000120
```

```
UIPLGG    SLAROM                                                        00000120
FOLL1W    SLAROM                                                        00000120
SHIELD    SLAROM                                                        00000120
LSHLDD    SLAROM                                                        00000120
RODI1A    SLAROM                                                        00000120
IC01VV    SLAROM                                                        00000120
IC02VV    SLAROM                                                        00000120
IC03VV    SLAROM                                                        00000120
IC04VV    SLAROM                                                        00000120
IC05VV    SLAROM                                                        00000120
IC06VV    SLAROM                                                        00000120
IC07VV    SLAROM                                                        00000120
IC08VV    SLAROM                                                        00000120
OC09VV    SLAROM                                                        00000120
OC10VV    SLAROM                                                        00000120
OC11VV    SLAROM                                                        00000120
OC12VV    SLAROM                                                        00000120
OC13VV    SLAROM                                                        00000120
OC14VV    SLAROM                                                        00000120
OC15VV    SLAROM                                                        00000120
OC16VV    SLAROM                                                        00000120
004                                                                     00000910
  5                                                                     00000920
008                                                                     00000960
  1  0  1 16  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16           00000920
IC01VV    SLAROM                                                        00000960
  1 23  2 24  3 25  4 26  5 27  6 28  7 29  8 30  9 31 10 32 11 33 12 3400000960
 13 35 14 36 15 37 16 38                                                00000960
999                                                                     00000960
                                                                        00000960
```

Data file [22] .OPEDID.DATA(PIJ3PFD0)

PERKY input, Doppler (by zone), for 'perturbation'

```
PERKY                                                                   00000010
IC01FF    SLAROM                                                        00000120
    18 GROUP DOPPLER PERTURBATION, FIRST ORDER ,  BY REGION
001
  1 18    38  1  0  0  0  1
003
  1  0  0
 38 38  0  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38
IC01FF    SLAROM                                                        00000270
 18 18  0  2  0  0  1  1  1                                            00000280
IC01FF    SLAROM                                                        00000120
IC02FF    SLAROM                                                        00000120
IC03FF    SLAROM                                                        00000120
IC04FF    SLAROM                                                        00000120
IC05FF    SLAROM                                                        00000120
IC06FF    SLAROM                                                        00000120
IC07FF    SLAROM                                                        00000120
```

```
IC08FF    SLAROM                                                        00000120
OC09FF    SLAROM                                                        00000120
OC10FF    SLAROM                                                        00000120
OC11FF    SLAROM                                                        00000120
OC12FF    SLAROM                                                        00000120
OC13FF    SLAROM                                                        00000120
OC14FF    SLAROM                                                        00000120
OC15FF    SLAROM                                                        00000120
OC16FF    SLAROM                                                        00000120
UIPLNN    SLAROM                                                        00000120
UIPLGG    SLAROM                                                        00000120
FOLL1W    SLAROM                                                        00000120
SHIELD    SLAROM                                                        00000120
LSHLDD    SLAROM                                                        00000120
RODI1A    SLAROM                                                        00000120
IC01DD    SLAROM                                                        00000120
IC02DD    SLAROM                                                        00000120
IC03DD    SLAROM                                                        00000120
IC04DD    SLAROM                                                        00000120
IC05DD    SLAROM                                                        00000120
IC06DD    SLAROM                                                        00000120
IC07DD    SLAROM                                                        00000120
IC08DD    SLAROM                                                        00000120
OC09DD    SLAROM                                                        00000120
OC10DD    SLAROM                                                        00000120
OC11DD    SLAROM                                                        00000120
OC12DD    SLAROM                                                        00000120
OC13DD    SLAROM                                                        00000120
OC14DD    SLAROM                                                        00000120
OC15DD    SLAROM                                                        00000120
OC16DD    SLAROM                                                        00000120
004                                                                     00000910
  4                                                                     00000920
008                                                                     00000960
  1  0  1 16  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16           00000920
IC01DD    SLAROM                                                        00000960
  1 23  2 24  3 25  4 26  5 27  6 28  7 29  8 30  9 31 10 32 11 33 12 3400000960
 13 35 14 36 15 37 16 38                                                00000960
999                                                                     00000960
                                                                        00000960
```

Data file [23] .OPEDID.DATA(GDI3PFD1)

PERKY input, Doppler (by nuclide), for 'perturbation'

```
PERKY                                                                   00000010
IC01FF    SLAROM                                                        00000120
 18 GROUP DOPPLER PERTURBATION, 1'ST ORDER, BY ISOTOPE, 1 TO 10 (OF 20)
001
  1 18    38  1  0  0  0  1
002
  1  0  0
 38 38  0  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
```

```
 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38
  1 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 940 941 949 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  2 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 940 941 949 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  3 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 940 941 949 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  4 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 940 941 949 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  5 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 940 941 949 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  6 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 940 941 949 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  7 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 940 941 949 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  8 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 940 941 949 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  9 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 10 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 11 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 12 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 13 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 14 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 15 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 16 20                                                                  00000280
IC01FF    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 17                                                                     00000280
IC01FF    SLAROM                                                        00000120
  11  26  24  28  42  25                                               00000120
 18   6                                                                 00000280
IC01FF    SLAROM                                                        00000120
  11  26  24  28  42  25                                               00000120
 19   6                                                                 00000280
IC01FF    SLAROM                                                        00000120
  11  26  24  28  42  25                                               00000120
 20   6                                                                 00000280
IC01FF    SLAROM                                                        00000120
  11  26  24  28  42  25                                               00000120
 21   6                                                                 00000280
IC01FF    SLAROM                                                        00000120
  11  26  24  28  42  25                                               00000120
 22   6                                                                 00000280
IC01FF    SLAROM                                                        00000120
  11  26  24  28  42  25                                               00000120
 23 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 24 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 25 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 26 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 27 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 28 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 29 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 30 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 31 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
```

```
  40   1
 32 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 33 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 34 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 35 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 36 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 37 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
 38 20                                                                  00000280
IC01DD    SLAROM                                                        00000120
 949 940 941 942 951 925 926 928   8  11  26  24  28  42   6 953 115 10500000120
  40   1
  1  1  2  2  3  3  4  4  5  5  6  6  7  7  8  8  9  9 10 10 11 11 12 12
 13 13 14 14 15 15 16 16 17 17 18 18 19 19 20 20 21 21 22 22 23 23 24 24
 25 25 26 26 27 27 28 28 29 29 30 30 31 31 32 32 33 33 34 34 35 35 36 36
 37 37 38 38
003
  1  0  0
 38 38  0  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38
IC01FF    SLAROM                                                        00000270
 18 18  0  2  0  0  1  1  1                                            00000280
IC01FF    SLAROM                                                        00000120
IC02FF    SLAROM                                                        00000120
IC03FF    SLAROM                                                        00000120
IC04FF    SLAROM                                                        00000120
IC05FF    SLAROM                                                        00000120
IC06FF    SLAROM                                                        00000120
IC07FF    SLAROM                                                        00000120
IC08FF    SLAROM                                                        00000120
OC09FF    SLAROM                                                        00000120
OC10FF    SLAROM                                                        00000120
OC11FF    SLAROM                                                        00000120
OC12FF    SLAROM                                                        00000120
OC13FF    SLAROM                                                        00000120
OC14FF    SLAROM                                                        00000120
OC15FF    SLAROM                                                        00000120
OC16FF    SLAROM                                                        00000120
UIPLNN    SLAROM                                                        00000120
UIPLGG    SLAROM                                                        00000120
FOLL1W    SLAROM                                                        00000120
SHIELD    SLAROM                                                        00000120
```

```
LSHLDD    SLAROM                                                        00000120
RODI1A    SLAROM                                                        00000120
IC01DD    SLAROM                                                        00000120
IC02DD    SLAROM                                                        00000120
IC03DD    SLAROM                                                        00000120
IC04DD    SLAROM                                                        00000120
IC05DD    SLAROM                                                        00000120
IC06DD    SLAROM                                                        00000120
IC07DD    SLAROM                                                        00000120
IC08DD    SLAROM                                                        00000120
OC09DD    SLAROM                                                        00000120
OC10DD    SLAROM                                                        00000120
OC11DD    SLAROM                                                        00000120
OC12DD    SLAROM                                                        00000120
OC13DD    SLAROM                                                        00000120
OC14DD    SLAROM                                                        00000120
OC15DD    SLAROM                                                        00000120
OC16DD    SLAROM                                                        00000120
004                                                                     00000910
  4                                                                     00000920
008                                                                     00000960
  0  1  1 16  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16           00000920
IC01DD    SLAROM                                                        00000960
    10   949   940   941   942   951   925   926   928     8    11     00000960
   949   940   941   942   951   925   926   928   105   115           00000960
 1 23 10                                                                00000960
  949 0.0         0.0                                                   00000960
  940 0.0         0.0                                                   00000960
  941 0.0         0.0                                                   00000960
  942 0.0         0.0                                                   00000960
  951 0.0         0.0                                                   00000960
  925 0.0         0.0                                                   00000960
  926 0.0         0.0                                                   00000960
  928 0.0         0.0                                                   00000960
    8 0.0         0.0                                                   00000960
   11 0.0         0.0                                                   00000960
 2 24 10                                                                00000960
  949 0.0         0.0                                                   00000960
  940 0.0         0.0                                                   00000960
  941 0.0         0.0                                                   00000960
  942 0.0         0.0                                                   00000960
  951 0.0         0.0                                                   00000960
  925 0.0         0.0                                                   00000960
  926 0.0         0.0                                                   00000960
  928 0.0         0.0                                                   00000960
    8 0.0         0.0                                                   00000960
   11 0.0         0.0                                                   00000960
 3 25 10                                                                00000960
  949 0.0         0.0                                                   00000960
  940 0.0         0.0                                                   00000960
  941 0.0         0.0                                                   00000960
  942 0.0         0.0                                                   00000960
  951 0.0         0.0                                                   00000960
  925 0.0         0.0                                                   00000960
  926 0.0         0.0                                                   00000960
  928 0.0         0.0                                                   00000960
    8 0.0         0.0                                                   00000960
   11 0.0         0.0                                                   00000960
 4 26 10                                                                00000960
```

```
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
5 27 10                                                                 00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
6 28 10                                                                 00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
7 29 10                                                                 00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
8 30 10                                                                 00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
9 31 10                                                                 00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
10 32 10                                                                00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
11 33 10                                                                00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
12 34 10                                                                00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
13 35 10                                                                00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
   8 0.0         0.0                                                    00000960
  11 0.0         0.0                                                    00000960
14 36 10                                                                00000960
 949 0.0         0.0                                                    00000960
 940 0.0         0.0                                                    00000960
 941 0.0         0.0                                                    00000960
 942 0.0         0.0                                                    00000960
 951 0.0         0.0                                                    00000960
 925 0.0         0.0                                                    00000960
 926 0.0         0.0                                                    00000960
 928 0.0         0.0                                                    00000960
```

```
     8 0.0          0.0                                                  00000960
    11 0.0          0.0                                                  00000960
 15 37 10                                                                00000960
   949 0.0          0.0                                                  00000960
   940 0.0          0.0                                                  00000960
   941 0.0          0.0                                                  00000960
   942 0.0          0.0                                                  00000960
   951 0.0          0.0                                                  00000960
   925 0.0          0.0                                                  00000960
   926 0.0          0.0                                                  00000960
   928 0.0          0.0                                                  00000960
     8 0.0          0.0                                                  00000960
    11 0.0          0.0                                                  00000960
 16 38 10                                                                00000960
   949 0.0          0.0                                                  00000960
   940 0.0          0.0                                                  00000960
   941 0.0          0.0                                                  00000960
   942 0.0          0.0                                                  00000960
   951 0.0          0.0                                                  00000960
   925 0.0          0.0                                                  00000960
   926 0.0          0.0                                                  00000960
   928 0.0          0.0                                                  00000960
     8 0.0          0.0                                                  00000960
    11 0.0          0.0                                                  00000960
999                                                                      00000960
                                                                         00000960
```

Data file [24] .OPMOSD.DATA(GDI1DY)

MOSES input, steady state, for 'rod worth'

```
GDI1S-HQPU40.25/45.03%,165%F,4*9.75M.,24/8PZRH/B4C(30%B10),45%HOLE,OPT.
SOC,  FCR 50% ,  BCR 100%   BCR Y(404) ROD STUCK  B OK 7 GROUPS
&& CORE 7,DETAILED,  IMPROVED AXIAL REFLECTORS RODS HOMO
&&   ------------------------------------------------------------------
&&
CONTROL
    3*1     &&  DIFFUSION CAL. ON
    3*0     &&  BURNUP CAL.    ON
EDIT
   0 4*1 2 19*0 1 4*0      &&  EDIT PROGRAM SETUP
   0 1 3*0 1 3*0 1 20*0    &&  EDIT FUEL MANAGEMENT DATA
   0 0 2 2 1 0 1 0 1 1 0 1 0 1 3 0 0 1 1 0 0 1 3*0 1 0 1 0 0  && DIF CAL
   3*0 1 4*0 1 0 2 5*0 9*0 1 4*0   &&  EDIT BURNUP CAL. DATA

EDITD
&&  $IC1 $IC2    $OC1
&&   DETAILED EDIT FOR DIFF. CAL.
     50*0.0
&&   DETAILED EDIT FOR BURNUP CAL.
     50*0.0
&&   DETAILED EDIT FOR N.D. CAL.
     50*0.0
EOB
```

```
&&
&&   ------------------------------------------------------------------
&&
LOADING 1
&&
GEOM
&&      NSYM NLAY NPLN NAZN NGRP  PITCH
          6   18   56   15   7     15.81
&&      AXIAL MESH BY REGION
     10 2 1 2  1  2  3 4 4 3  2  1  1 14 6
&&      REGION WIDTH (CM)
 50.0 7.0 3.0 5.0 3.0 6.0 9.0 12.0 12.0 9.0 6.0 3.0 2.0 70.0 33.0
&&      === NMES  ( NMES=1:CM, NMES=2:MOD.CM)
&&      NMES NCAL NITR NIIT NITM NBATCH OUTCR RLOSS   DELAY NSMALL
CPARA1   2    0   200   3  1600    0  0  0  0  0  3*0  182.5  1
CPARA2   5.E-6 1.E-4 0.5 1.5 1 0.0 4*0 0.0 0 0.0
EOB
&&
&&   ------------------------------------------------------------------
&&
&&        ASSEMBLY AXIAL INFORMATIONS
AXIAL
&&     NREGZ
  15    28 27 26 25  1  2  3  4  5  6  7  8 26 25 29 &&  INNER FUEL
    50.0 7.0 3.0 5.0 3.0 6.0 9.0 12.0 12.0 9.0 6.0 3.0 2.0 70.0 33.0
  15    28 27 26 25 9 10 11 12 13 14 15 16 26 25 29 &&  OUTER FUEL1
    50.0 7.0 3.0 5.0 3.0 6.0 9.0 12.0 12.0 9.0 6.0 3.0 2.0 70.0 33.0
  15    28 27 26 25 17 18 19 20 21 22 23 24 26 25 29 &&  OUTER FUEL2
    50.0 7.0 3.0 5.0 3.0 6.0 9.0 12.0 12.0 9.0 6.0 3.0 2.0 70.0 33.0
   1    28                                              && RADIAL SHIELD
        230.0
   3              30  27    29                         && ROD 0%
             65.0       132.0 33.0
   4    27 30  27     29                               && ROD 50%
        50.0  45.0 102.0       33.0
   4    27  30  27    29                               && ROD 100%
        65.0  60.0  72.0 33.0
EOI
&&    ASSEMBLY GROUP ASSIGNMENT
ASYGROUP
      1  1  1  1  1 IC1   INNER CORE
      1  2  1  2  2 OC1   OUTER CORE1
      1  3  1  2  2 OC2   OUTER CORE2
      1  4  1  4  3 SHD   RADIAL SHIELD
      2  5  1  4 -4 R0%   ROD 0%
      2  6  1  4 -5 R50   ROD 50%
      2  7  1  4 -6 RIN   ROD 100%
EOI
&&    MATERIAL ASSIGNMENT
REGION
      1  1  1  1  1 $IC1   INNER CORE1
      1  1  1  1  1 $IC2   INNER CORE2
      1  1  1  1  1 $IC3   INNER CORE3
      1  1  1  1  1 $IC4   INNER CORE4
      1  1  1  1  1 $IC5   INNER CORE5
      1  1  1  1  1 $IC6   INNER CORE6
      1  1  1  1  1 $IC7   INNER CORE7
      1  1  1  1  1 $IC8   INNER CORE8
      2  2  1  1  1 $O11   OUTER CORE1/1
```

```
      2  2  1  1  1 $O12    OUTER CORE1/2
      2  2  1  1  1 $O13    OUTER CORE1/3
      2  2  1  1  1 $O14    OUTER CORE1/4
      2  2  1  1  1 $O15    OUTER CORE1/5
      2  2  1  1  1 $O16    OUTER CORE1/6
      2  2  1  1  1 $O17    OUTER CORE1/7
      2  2  1  1  1 $O18    OUTER CORE1/8
      2  3  1  1  1 $O21    OUTER CORE2/1
      2  3  1  1  1 $O22    OUTER CORE2/2
      2  3  1  1  1 $O23    OUTER CORE2/3
      2  3  1  1  1 $O24    OUTER CORE2/4
      2  3  1  1  1 $O25    OUTER CORE2/5
      2  3  1  1  1 $O26    OUTER CORE2/6
      2  3  1  1  1 $O27    OUTER CORE2/7
      2  3  1  1  1 $O28    OUTER CORE2/8
      3  4  1  3  1 $PLN    PLENUM AXIAL
      4  5  1  3  1 $PLG    PLUG AXIAL
      5  6  1  3  1 $FOL    GAP FOLLOWER
      6  7  1  5  1 $URS    UP/RAD SHLD
      7  8  1  3  1 $LSH    LOWER SHIELD
      9  9  1  6  1 $ABS    ROD ABSORBER
EOI
&&
&&    CROSS SECTION AND FISSION SPECTRUM
&&
MICROXS
   1  9  33  2  1  2
   1.4782E-1 4.5751E-1 3.8563E-1 8.7542E-3 2.807E-4 0.0 0.0
&&
&&    NUCLIDE INFORMATION
&&
XSNUC
&& CODE  NAME   IFIS  KIND  BCAL KLIB  ATW    EFIS ECAP DECAY
    1  PU239      2     1     0   1  239.05   3.34E-11 0    0
    2  PU240      2     2     0   1  240.05   3.36E-11 0    0
    3  PU241      2     1     0   1  241.06   3.37E-11 0 1.526E-9
    4  PU242      2     3     0   1  242.06   3.38E-11 0    0
    5  AM241      2     3     0   1  241.06   3.36E-11 0    0
    6   U235      1     3     0   1  235.044  3.23E-11 0    0
    7   U236      1     3     0   1  236.05   3.24E-11 0    0
    8   U238      1     2     0   1  238.051  3.31E-11 0    0
    9      O      0     5     0   1   15.999   0        0    0
   10     NA      0     6     0   1   22.990   0        0    0
   11     FE      0     6     0   1   55.847   0        0    0
   12     CR      0     6     0   1   51.996   0        0    0
   13     NI      0     6     0   1   58.70    0        0    0
   14     MO      0     6     0   1   95.94    0        0    0
   15     MN      0     6     0   1   54.938   0        0    0
   18      C      0     7     0   1   12.011   0        0    0
   20     ZR      0     6     0   1   91.224   0        0    0
   21  NP237      0     6     0   1  237.048  3.30E-11 0    0
   22  NP239      0     6     0   1  239.053  3.31E-11 0    0
   23  AM242M     0     6     0   1  242.060  3.45E-11 0    0
   24  AM243      0     6     0   1  243.061  3.46E-11 0    0
   25  CM242      0     6     0   1  242.059  3.52E-11 0    0
   26  CM243      0     6     0   1  243.060  3.52E-11 0    0
   27  CM244      0     6     0   1  244.063  3.53E-11 0    0
   28  CM245      0     6     0   1  245.066  3.53E-11 0    0
   29  PU238      2     3     0   1  238.05   3.33E-11 0    0
   67   B-10      0     7     0   1   10.0123  0        0    0
   68   B-11      0     7     0   1   11.0093  0        0    0
   70   H         0     7     0   1    1.0078  0        0    0
   78   U238-FP  -1     4     0   1  238.051   0        0    0
   79  PU239-FP  -1     4     0   1  239.055   0        0    0
   80   U235-FP  -1     4     0   1  235.044   0        0    0
   81  PU241-FP  -1     4     0   1  241.057   0        0    0
REACT1
    6    7    2   1.0
    8    1    2   1.0
    1    2    2   1.0
    2    3    2   1.0
    3    4    2   1.0
   29    1    2   1.0
    3    5    1   1.0
    0
YIELD
   78    8 1.0
   79    1 1.0
   79    2 1.0
   79   29 1.0
   80    6 1.0
   80    7 1.0
   81    3 1.0
   81    4 1.0
   81    5 1.0
&&
&&       ATOM NUMBER DENSITY
&&
ATDEN
&&    FROM  .OPFORT(GDI1RDRZ)
&&  ZONE   1
   1.46918E-03  1.74999E-04  9.65638E-06  3.30258E-07
   3.79707E-07  6.73607E-06  3.35554E-07  2.60913E-03
   8.90358E-03  1.03968E-02  1.17896E-02  3.28651E-03
   2.31220E-03  2.61937E-04  2.74457E-04
                2.84691E-04               1.28188E-03
   2.91854E-07  3.71285E-07  6.62542E-09  1.22009E-08
   1.51758E-08  3.82196E-10  8.50733E-10  2.37739E-11
   4.90057E-08
   2.83107E-04  7.74029E-04
   2.17919E-03
   9.15262E-06  2.09324E-04  1.09239E-06
   5.96565E-06
&&  ZONE   2
   1.44892E-03  1.77607E-04  1.00720E-05  3.65641E-07
   3.93013E-07  6.62858E-06  3.51142E-07  2.60133E-03
   8.90358E-03  1.03968E-02  1.17896E-02  3.28651E-03
   2.31220E-03  2.61937E-04  2.74457E-04
                2.84691E-04               1.28188E-03
   3.68157E-07  4.00145E-07  7.22962E-09  1.38310E-08
   1.66777E-08  4.39829E-10  1.01782E-09  2.96814E-11
   6.21125E-08
   2.78976E-04  7.74029E-04
   2.17919E-03
   1.17643E-05  2.30406E-04  1.18318E-06
   7.26002E-06
&&  ZONE   3
```

```
.....................

REPETITIVE DATA REMOVED
.....................

&&  ZONE  24
   1.72011E-03  1.77176E-04  7.91079E-06  1.98700E-07
   3.22824E-07  6.58690E-06  2.35864E-07  2.42671E-03
   8.92029E-03  1.03968E-02  1.17896E-02  3.28651E-03
   2.31221E-03  2.61937E-04  2.74458E-04
                2.84691E-04               1.28188E-03
   1.49815E-07  2.43232E-07  4.18611E-09  5.90895E-09
   9.29809E-09  1.76758E-10  3.03483E-10  6.46939E-12
   2.18182E-08
   3.02515E-04  7.74028E-04
   2.17919E-03
   4.48776E-06  1.57107E-04  7.08526E-07
   3.33516E-06
&&  ZONE  25
 0 0 0 0 0 0 0 0 0
   1.03970E-02  1.17900E-02  3.28650E-03  2.31220E-03
   2.61950E-04  2.74470E-04
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
&&  ZONE  26
 0 0 0 0 0 0 0 0 0
   1.03970E-02  2.96650E-02  8.26929E-03  5.81799E-03
   6.59100E-04  6.90609E-04
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
&&  ZONE  27
 0 0 0 0 0 0 0 0 0
   1.99080E-02  5.24169E-03  1.46120E-03  1.02800E-03
   1.16460E-04  1.22020E-04
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
&&  ZONE  28
 0 0 0 0 0 0 0 0 0
   4.38990E-03  4.50900E-02  1.25690E-02  8.84310E-03
   1.00180E-03  1.04970E-03
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
&&  ZONE  29
 0 0 0 0 0 0 0 0 0
   6.36540E-03  1.77540E-02  4.94900E-03  3.48200E-03
   3.94460E-04  4.13320E-04  9.24600E-03 0 0 0 0 0 0 0 0 0 0 7.89610E-03
   2.90880E-02
 0 0 0 0 0
&&  ZONE  30
 0 0 0 0 0 0 0 0 0
   9.32849E-03  1.27380E-02  3.55070E-03  2.49820E-03
   2.83010E-04  2.96540E-04  8.22779E-03 0 0 0 0 0 0 0 0 0 0 3.04990E-02
   2.41210E-03
 0 0 0 0 0
EOI
&&      === CAUTION ===  REFLECTIVE B.C. IS NOT PERMITTED
&&       0.0 MEANS VACUUM
BOUNDARY
   7*0.0
   7*0.0
   7*0.0
REFUEL
   1   0   365.0
   0   0   0.0
   0   0   0.0
   0   0   0.0
   0   0   0.0
   0   0   0.0
   0   0   0.0
   0   0   0.0
   0   0   0.0
   0   0   0.0
REFMAP
1STCORE
     1 271    1
   272 547    2
   548 721    4
   553 557    3
   567 571    3
   581 585    3
   595 599    3
   609 613    3
   623 627    3
   547 547    3
   470 471    3
   482 484    3
   495 497    3
   508 510    3
   521 523    3
   534 536    3
   722 817    4
   825 829    4
   842 846    4
   859 863    4
   876 880    4
   893 897    4
   910 914    4
    92  92    7
    98  98    7
   104 104    7
   110 110    7
   116 116    7
   122 122    7
   404 404    5
   416 416    7
   428 428    7
   440 440    7
   452 452    7
   464 464    7
    20  20    6
    23  23    6
    26  26    6
    29  29    6
    32  32    6
    35  35    6
    95  95    6
   101 101    6
   107 107    6
   113 113    6
   119 119    6
   125 125    6
   218 218    6
```

```
  221 221    6
  224 224    6
  227 227    6
  230 230    6
  233 233    6
  236 236    6
  239 239    6
  242 242    6
  245 245    6
  248 248    6
  251 251    6
  254 254    6
  257 257    6
  260 260    6
  263 263    6
  266 266    6
  269 269    6
  401 401    6
  407 407    6
  413 413    6
  419 419    6
  425 425    6
  431 431    6
  437 437    6
  443 443    6
  449 449    6
  455 455    6
  461 461    6
  467 467    6
    0   0    0
EOI
PLANT
1560.0 380
CRPOS
 && IC1 OC1  RS1   MCR   BCR  CRP
    0.0 0.0  0.0   0.0   0.0  0.0  34*0.0
EOB
```

Data file [25] .OPDEND.DATA(GDI1RZEC)

SLAROM input for 'shutdown margin'

```
PREP
 INNER CORE, GDI1 (OPTIMIZED) EXPANSION COEFFICIENT
  1  1  0  0  0  0  3  -20  0  0  0  0  70
1373.15  0.0  0.0
85
1.0
 949 1.40054E-03 940 1.89123E-04 941 1.27770E-05 942 5.72363E-07
 951 4.85452E-07 925 6.33711E-06 926 4.10550E-07 928 2.58219E-03
   8 8.90358E-03  11 1.03968E-02  26 1.17896E-02  24 3.28650E-03
  28 2.31220E-03  42 2.61937E-04  25 2.74457E-04 884 0.00000E+00
 894 0.00000E+00   6 2.84691E-04 157 0.00000E+00  40 1.28188E-03
 937 4.55646E-07 939 4.87843E-07 950 1.08070E-08 953 2.69633E-08
 962 2.55573E-08 963 8.26626E-10 964 2.49699E-09 965 9.16727E-11
 948 9.44290E-08 854 0.00000E+00 814 0.00000E+00 966 0.00000E+00
 967 0.00000E+00 968 0.00000E+00 439 0.00000E+00 579 0.00000E+00
 580 0.00000E+00 582 0.00000E+00 584 0.00000E+00 591 0.00000E+00
 603 0.00000E+00 604 0.00000E+00 605 0.00000E+00 606 0.00000E+00
 608 0.00000E+00 600 0.00000E+00 617 0.00000E+00 627 0.00000E+00
 628 0.00000E+00 620 0.00000E+00 622 0.00000E+00 631 0.00000E+00
 633 0.00000E+00 634 0.00000E+00 644 0.00000E+00 646 0.00000E+00
 648 0.00000E+00  82 0.00000E+00 839 0.00000E+00  12 0.00000E+00
  39 0.00000E+00 441 0.00000E+00 442 0.00000E+00 443 0.00000E+00
 529 0.00000E+00 555 0.00000E+00 105 2.63858E-04 115 7.74028E-04
 147 0.00000E+00   1 2.17919E-03 402 0.00000E+00   4 0.00000E+00
  13 0.00000E+00  63 0.00000E+00  73 0.00000E+00  74 0.00000E+00
  20 0.00000E+00 887 1.50137E-05 897 2.77085E-04 857 1.40819E-06
 817 1.02094E-05 889 0.00000E+00 899 0.00000E+00 859 0.00000E+00
 819 0.00000E+00
INCORE
PREP
 OUTER CORE, GDI1 (OPTIMIZED) EXPANSION COEFFICIENT
  1  1  0  0  0  0  3  -20  0  0  0  0  70
1373.15  0.0  0.0
85
1.0
 949 1.65298E-03 940 1.85560E-04 941 8.98239E-06 942 2.81111E-07
 951 3.57843E-07 925 6.30652E-06 926 2.76787E-07 928 2.40805E-03
   8 8.92030E-03  11 1.03968E-02  26 1.17896E-02  24 3.28651E-03
  28 2.31221E-03  42 2.61937E-04  25 2.74458E-04 884 0.00000E+00
 894 0.00000E+00   6 2.84691E-04 157 0.00000E+00  40 1.28187E-03
 937 3.29710E-07 939 3.14183E-07 950 5.66737E-09 953 9.08185E-09
 962 1.28874E-08 963 2.95563E-10 964 5.87203E-10 965 1.52412E-11
 948 4.78690E-08 854 0.00000E+00 814 0.00000E+00 966 0.00000E+00
 967 0.00000E+00 968 0.00000E+00 439 0.00000E+00 579 0.00000E+00
 580 0.00000E+00 582 0.00000E+00 584 0.00000E+00 591 0.00000E+00
 603 0.00000E+00 604 0.00000E+00 605 0.00000E+00 606 0.00000E+00
 608 0.00000E+00 600 0.00000E+00 617 0.00000E+00 627 0.00000E+00
 628 0.00000E+00 620 0.00000E+00 622 0.00000E+00 631 0.00000E+00
 633 0.00000E+00 634 0.00000E+00 644 0.00000E+00 646 0.00000E+00
 648 0.00000E+00  82 0.00000E+00 839 0.00000E+00  12 0.00000E+00
  39 0.00000E+00 441 0.00000E+00 442 0.00000E+00 443 0.00000E+00
 529 0.00000E+00 555 0.00000E+00 105 2.91455E-04 115 7.74030E-04
 147 0.00000E+00   1 2.17918E-03 402 0.00000E+00   4 0.00000E+00
  13 0.00000E+00  63 0.00000E+00  73 0.00000E+00  74 0.00000E+00
  20 0.00000E+00 887 1.04505E-05 897 2.23876E-04 857 9.45563E-07
 817 6.79008E-06 889 0.00000E+00 899 0.00000E+00 859 0.00000E+00
 819 0.00000E+00
OTCORE
PREP
PLENUM UP&LO,LO Q PU,165%FUEL,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 1.17900E-02  24 3.28650E-03  28 2.31220E-03
   42 2.61950E-04  25 2.74470E-04
PLENUM
PREP
PLUGGED PIN, LO Q ,165%FUEL
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
```

```
  6
 1.0
   11 1.03970E-02  26 2.96650E-02  24 8.26930E-03  28 5.81800E-03
   42 6.59100E-04  25 6.90610E-04
PLUGGD
PREP
ROD FOLLOWER/GAP,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.99080E-02  26 5.24170E-03  24 1.46120E-03  28 1.02800E-03
   42 1.16460E-04  25 1.22020E-04
FOLLOW
PREP
UPP/RAD'L SH'LD,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 4.38990E-03  26 4.50900E-02  24 1.25690E-02  28 8.84310E-03
   42 1.00180E-03  25 1.04970E-03
UPPSHD
PREP
LOWER SHIELD,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  9
 1.0
   11 6.36540E-03  26 1.77540E-02  24 4.94900E-03  28 3.48200E-03
   42 3.94460E-04  25 4.13320E-04   6 9.24600E-03 105 7.89610E-03
  115 2.90880E-02
LOWSHD
PREP
ROD ABSORBER HOMOGENEOUE  GDI1
  1  1  0  0  0  0  3 -20  0  0  0  0 70
  703.15  0.0  0.0
 9
 1.0
   11 9.32849E-03  26 1.27380E-02  24 3.55070E-03  28 2.49820E-03
   42 2.83010E-04  25 2.96540E-04   6 8.22779E-03 105 3.04990E-02
  115 2.41210E-03
AHOMOG
PREP
 INNER CORE, GDI1 (OPTIMIZED) EXPANSION COEFFICIENT
  1  1  0  0  0  0  3  -20  0  0  0  0  70
 1373.15  0.0  0.0
 85
 1.0
  949 1.40054E-03 940 1.89123E-04 941 1.27770E-05 942 5.72363E-07
  951 4.85452E-07 925 6.33711E-06 926 4.10550E-07 928 2.58219E-03
    8 8.90358E-03  11 1.03968E-02  26 1.17896E-02  24 3.28650E-03
   28 2.31220E-03  42 2.61937E-04  25 2.74457E-04 884 0.00000E+00
  894 0.00000E+00   6 2.84691E-04 157 0.00000E+00  40 1.28188E-03
  937 4.55646E-07 939 4.87843E-07 950 1.08070E-08 953 2.69633E-08
  962 2.55573E-08 963 8.26626E-10 964 2.49699E-09 965 9.16727E-11
  948 9.44290E-08 854 0.00000E+00 814 0.00000E+00 966 0.00000E+00
  967 0.00000E+00 968 0.00000E+00 439 0.00000E+00 579 0.00000E+00
  580 0.00000E+00 582 0.00000E+00 584 0.00000E+00 591 0.00000E+00
  603 0.00000E+00 604 0.00000E+00 605 0.00000E+00 606 0.00000E+00
  608 0.00000E+00 600 0.00000E+00 617 0.00000E+00 627 0.00000E+00
  628 0.00000E+00 620 0.00000E+00 622 0.00000E+00 631 0.00000E+00
  633 0.00000E+00 634 0.00000E+00 644 0.00000E+00 646 0.00000E+00
  648 0.00000E+00  82 0.00000E+00 839 0.00000E+00  12 0.00000E+00
   39 0.00000E+00 441 0.00000E+00 442 0.00000E+00 443 0.00000E+00
  529 0.00000E+00 555 0.00000E+00 105 2.63858E-04 115 7.74028E-04
  147 0.00000E+00   1 2.17919E-03 402 0.00000E+00   4 0.00000E+00
   13 0.00000E+00  63 0.00000E+00  73 0.00000E+00  74 0.00000E+00
   20 0.00000E+00 887 1.50137E-05 897 2.77085E-04 857 1.40819E-06
  817 1.02094E-05 889 0.00000E+00 899 0.00000E+00 859 0.00000E+00
  819 0.00000E+00
INCDDD
PREP
 OUTER CORE, GDI1 (OPTIMIZED) EXPANSION COEFFICIENT
  1  1  0  0  0  0  3  -20  0  0  0  0  70
 1373.15  0.0  0.0
 85
 1.0
  949 1.65298E-03 940 1.85560E-04 941 8.98239E-06 942 2.81111E-07
  951 3.57843E-07 925 6.30652E-06 926 2.76787E-07 928 2.40805E-03
    8 8.92030E-03  11 1.03968E-02  26 1.17896E-02  24 3.28651E-03
   28 2.31221E-03  42 2.61937E-04  25 2.74458E-04 884 0.00000E+00
  894 0.00000E+00   6 2.84691E-04 157 0.00000E+00  40 1.28187E-03
  937 3.29710E-07 939 3.14183E-07 950 5.66737E-09 953 9.08185E-09
  962 1.28874E-08 963 2.95563E-10 964 5.87203E-10 965 1.52412E-11
  948 4.78690E-08 854 0.00000E+00 814 0.00000E+00 966 0.00000E+00
  967 0.00000E+00 968 0.00000E+00 439 0.00000E+00 579 0.00000E+00
  580 0.00000E+00 582 0.00000E+00 584 0.00000E+00 591 0.00000E+00
  603 0.00000E+00 604 0.00000E+00 605 0.00000E+00 606 0.00000E+00
  608 0.00000E+00 600 0.00000E+00 617 0.00000E+00 627 0.00000E+00
  628 0.00000E+00 620 0.00000E+00 622 0.00000E+00 631 0.00000E+00
  633 0.00000E+00 634 0.00000E+00 644 0.00000E+00 646 0.00000E+00
  648 0.00000E+00  82 0.00000E+00 839 0.00000E+00  12 0.00000E+00
   39 0.00000E+00 441 0.00000E+00 442 0.00000E+00 443 0.00000E+00
  529 0.00000E+00 555 0.00000E+00 105 2.91455E-04 115 7.74030E-04
  147 0.00000E+00   1 2.17918E-03 402 0.00000E+00   4 0.00000E+00
   13 0.00000E+00  63 0.00000E+00  73 0.00000E+00  74 0.00000E+00
   20 0.00000E+00 887 1.04505E-05 897 2.23876E-04 857 9.45563E-07
  817 6.79008E-06 889 0.00000E+00 899 0.00000E+00 859 0.00000E+00
  819 0.00000E+00
OTCDDD
PREP
PLENUM UP&LO,LO Q PU,165%FUEL,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 1.17900E-02  24 3.28650E-03  28 2.31220E-03
   42 2.61950E-04  25 2.74470E-04
PLEDDD
PREP
PLUGGED PIN, LO Q ,165%FUEL
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.03970E-02  26 2.96650E-02  24 8.26930E-03  28 5.81800E-03
   42 6.59100E-04  25 6.90610E-04
```

```
PLUDDD
PREP
ROD FOLLOWER/GAP,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 1.99080E-02  26 5.24170E-03  24 1.46120E-03  28 1.02800E-03
   42 1.16460E-04  25 1.22020E-04
FOLDDD
PREP
UPP/RAD'L SH'LD,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  6
 1.0
   11 4.38990E-03  26 4.50900E-02  24 1.25690E-02  28 8.84310E-03
   42 1.00180E-03  25 1.04970E-03
UPPDDD
PREP
LOWER SHIELD,
  1  1  0  0  0  0  3 -20  0  0  0  0 70
 703.15 0.0 0.0
  9
 1.0
   11 6.36540E-03  26 1.77540E-02  24 4.94900E-03  28 3.48200E-03
   42 3.94460E-04  25 4.13320E-04   6 9.24600E-03 105 7.89610E-03
  115 2.90880E-02
LOWDDD
PREP
ROD ABSORBER HOMOGENEOUE  GDI1
  1  1  0  0  0  0  3 -20  0  0  0  0 70
  703.15  0.0  0.0
 9
 1.0
   11 9.32849E-03  26 1.27380E-02  24 3.55070E-03  28 2.49820E-03
   42 2.83010E-04  25 2.96540E-04   6 8.22779E-03 105 3.04990E-02
  115 2.41210E-03
AHODDD
```

Data file [26] .OPCITD.DATA(PFC3N70X)

CITATION input, normal, for 'shutdown margin'

```
CITATION                                                                  00000010
INCOR     SLAROM                                                          00000120
  600MW / 60 CM PU BURNING CORE , PU VECTOR STUDY , HIGH QUALITY PU
   COARSE MODEL - 8 MATERIALS    OPTIMIZED CORE, RODS 0% EXPANSION
001
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0
  1  0  0  0  1  0  0  1  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0


003
  0  0  0  0  7  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0
   1.0000E-4   1.0000E-5

004
 10 46.21720  1  4.27490  7 38.52480  1  2.2926   1  2.2365   7 38.48690
  1  4.61620  6 28.74400  1  1.24510  1  2.4628   6 30.29210  8 42.20000

 10 50.00000  2  7.00000  1  3.00000  2  5.00000 20 60.00000  1  2.00000
 14 70.00000  6 33.00000
005
  6  8  6  8  8  6  8  6  8  8  6  6
  5  8  5  8  8  5  8  5  8  8  5  6
  4  8  4  8  8  4  8  4  8  8  4  6
  3  8  3  8  8  3  8  3  8  8  3  6
  1  5  1  5  5  1  5  2  5  5  2  6
  4  5  4  5  5  4  5  4  5  5  4  6
  3  5  3  5  5  3  5  3  5  5  3  6
  7  7  7  7  7  7  7  7  7  7  7  6
008                                                                       00000270
-70 70  0  8  2  1  1  3                                                  00000280
  1                                                                       00000290
INCOR     SLAROM                                                          00000120
  2                                                                       00000290
OTCOR     SLAROM                                                          00000120
  3                                                                       00000290
PLENU     SLAROM                                                          00000120
  4                                                                       00000290
PLUGG     SLAROM                                                          00000120
  5                                                                       00000290
FOLLO     SLAROM                                                          00000120
  6                                                                       00000290
UPPSH     SLAROM                                                          00000120
  7                                                                       00000290
LOWSH     SLAROM                                                          00000120
  8                                                                       00000290
AHOMO     SLAROM                                                          00000120
                                                                          00000290
INCOR     SLAROM                                                          00000120
023                                                                       00000910
  0  0  0  7                                                             00000920
999                                                                       00000960
```

Data file [27] .OPEDID.DATA(PFC3FX)

flux extract JOINT input, normal, for 'shutdown margin'

```
CITATIONPOST

0
 70   8  1  0
INCOR                                                                     00000120
OTCOR                                                                     00000120
PLENU                                                                     00000120
```

```
PLUGG                                                                  00000120
FOLLO                                                                  00000120
UPPSH                                                                  00000120
LOWSH                                                                  00000120
AHOMO                                                                  00000120
```

Data file [28] .OPEDID.DATA(PFC3C18X)

condensation JOINT input, 18 groups, normal, for 'shutdown margin'

```
CITATIONPOST                                                           00000010
                                                                       00000020
1                                                                      00000030
18                                                                     00000040
  2  4  6  8 10 13 16 19 22 25 28 31 34 37 40 43 46 70                 00000050
PDSIN   INCOR   SLAR  0  1                                            00000060
PDSOUT  INCOR   SLAR                                                   00000070
USERPDS INCOR   CITA                                                   00000080
 INNER-CORE      OPTIMIZED CORE                                        00000020
PDSIN   OTCOR   SLAR  0  1                                            00000060
PDSOUT  OTCOR   SLAR                                                   00000070
USERPDS OTCOR   CITA                                                   00000080
 OUTER-CORE      OPTIMIZED CORE                                        00000020
PDSIN   PLENU   SLAR  0  1                                            00000060
PDSOUT  PLENU   SLAR                                                   00000070
USERPDS PLENU   CITA                                                   00000080
 PLENUM          OPTIMIZED CORE                                        00000020
PDSIN   PLUGG   SLAR  0  1                                            00000060
PDSOUT  PLUGG   SLAR                                                   00000070
USERPDS PLUGG   CITA                                                   00000080
 STEEL PLUG      OPTIMIZED CORE                                        00000020
PDSIN   FOLLO   SLAR  0  1                                            00000060
PDSOUT  FOLLO   SLAR                                                   00000070
USERPDS FOLLO   CITA                                                   00000080
 ROD FOLLOWER    OPTIMIZED CORE                                        00000020
PDSIN   UPPSH   SLAR  0  1                                            00000060
PDSOUT  UPPSH   SLAR                                                   00000070
USERPDS UPPSH   CITA                                                   00000080
 UPPER-SH'D      OPTIMIZED CORE                                        00000020
PDSIN   LOWSH   SLAR  0  1                                            00000060
PDSOUT  LOWSH   SLAR                                                   00000070
USERPDS LOWSH   CITA                                                   00000080
 RAD'L-SH'D      OPTIMIZED CORE                                        00000020
PDSIN   AHOMO   SLAR  0  1                                            00000060
PDSOUT  AHOMO   SLAR                                                   00000070
USERPDS AHOMO   CITA                                                   00000080
 ROD ABSORBER    OPTIMIZED CORE                                        00000020
```


Data file [29] .OPEDID.DATA(PFC3MX)

x-sectio re-formatting JOINT input, normal, for 'shutdown margin'

```
CITATIONMICRO                                                          00000100
INCOR     SLAROM                                                       00000200
 85                                                                    00000300
  1 949  PU239     239.0530    0.334000E-10                            00000400
  2 940  PU240     240.0540    0.336   E-10                            00000410
  3 941  PU241     241.0570    0.337   E-10                            00000420
  4 942  PU242     242.0580    0.338   E-10                            00000420
  5 951  AM241     241.0750    0.336   E-10                            00000420
  6 925   U235     235.0440    0.323   E-10                            00000420
  7 926   U236     236.0460    0.324   E-10                            00000420
  8 928   U238     238.0510    0.331   E-10                            00000420
  9   8   O         15.9994    0.0                                     00000420
 10  11   NA        22.9898    0.0                                     00000420
 11  26   FE        55.8470    0.0                                     00000420
 12  24   CR        51.9961    0.0                                     00000400
 13  28   NI        58.6900    0.0                                     00000410
 14  42   MO        95.9400    0.0                                     00000420
 15  25   MN        54.9380    0.0                                     00000420
 16 884   U-238FP   238.0       0.0                                    00000420
 17 894   PU-239FP  239.0       0.0                                    00000420
 18   6   C         12.011     0.0                                     00000420
 19 157   N15       15.000     0.0                                     00000420
 20  40   ZR        91.224     0.0
 21 937  NP237     237.048    0.330000E-10
 22 939  NP239     239.053    0.331000E-10
 23 950  AM242M    242.060    0.345000E-10
 24 953  AM243     243.061    0.346000E-10
 25 962  CM242     242.059    0.352000E-10
 26 963  CM243     243.060    0.352000E-10
 27 964  CM244     244.063    0.353000E-10
 28 965  CM245     245.066    0.353000E-10
 29 948  PU238     238.050    0.337000E-10
 30 854  U235-FP   235.0      0.0
 31 814  PU241-FP  241.0      0.0
 32 966  CM246     246.0      0.354000E-10
 33 967  CM247     247.0      0.354000E-10
 34 968  CM248     248.0      0.354000E-10
 35 439  TC99       99.0      0.0
 36 579  LA139     139.0      0.0
 37 580  CE140     140.0      0.0
 38 582  CE142     142.0      0.0
 39 584  CE144     144.0      0.0
 40 591  PR141     141.0      0.0
 41 603  ND143     143.0      0.0
 42 604  ND144     144.0      0.0
 43 605  ND145     145.0      0.0
 44 606  ND146     146.0      0.0
 45 608  ND148     148.0      0.0
 46 600  ND150     150.0      0.0
 47 617  PM147     146.915    0.0
 48 627  SM147     147.0      0.0
```

```
 49 628  SM148     148.0       0.0
 50 620  SM150     150.0       0.0
 51 622  SM152     152.0       0.0
 52 631  EU151     150.919     0.0
 53 633  EU153     152.921     0.0
 54 634  EU154     154.0       0.0
 55 644  GD154     154.0       0.0
 56 646  GD156     155.922     0.0
 57 648  GD158     157.924     0.0
 58  82  PB56      207.2       0.0
 59 839  BI209     209.0       0.0
 60  12  MG        24.305      0.0
 61  39  Y         88.9069     0.0
 62 441  RU101     100.906     0.0
 63 442  RU102     101.904     0.0
 64 443  RU103     102.906     0.0
 65 529  I129      128.905     0.0
 66 555  CS135     134.906     0.0
 67 105  B10       10.0129     0.0                                    00000420
 68 115  B11       11.0093     0.0                                    00000420
 69 147  N14       14.0031     0.0
 70   1  H          1.0078     0.0
 71 402  HE         4.0026     0.0
 72   4  BE         9.0122     0.0
 73  13  AL27      26.9818     0.0
 74  63  LI6        6.0151     0.0
 75  73  LI7        7.0160     0.0
 76  74  W-NAT    183.8500     0.0
 77  20  CA        40.0800     0.0
 78 887  U238-FP   238.0       0.0
 79 897  PU239-FP  239.0       0.0
 80 857  U235-FP   235.0       0.0
 81 817  PU241-FP  241.0       0.0
 82 889  U238-FP   238.0       0.0
 83 899  PU239-FP  239.0       0.0
 84 859  U235-FP   235.0       0.0
 85 819  PU241-FP  241.0       0.0
INCOR       85 INNE CORE REGION
  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 2400000280
 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72
 73 74 75 76 77 78 79 80 81 82 83 84 85
OTCOR       85  OUT CORE REGION
  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 2400000280
 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72
 73 74 75 76 77 78 79 80 81 82 83 84 85
PLENU        6  PLENUM                                               00000310
 10 11 12 13 14 15                                                  00000280
PLUGG        6  STEEL PLUG                                          00000310
 10 11 12 13 14 15                                                  00000280
FOLLO        6  ROD FOLLOWER                                        00000320
 10 11 12 13 14 15                                                  00000280
UPPSH        6  UPPER SHIELD                                        00000310
 10 11 12 13 14 15                                                  00000280
LOWSH        9  LOWER   SHIELD                                      00000310
 10 11 12 13 14 15 18 67 68                                         00000280
AHOMO        9  ROD ABSORBER                                       00000320
 10 11 12 13 14 15 18 67 68                                         00000280
```


00000900

Data file [30] .OPEDID.DATA(NAMEF#XX)

PERKY package input, material zones, for 'shutdown margin'

```
INCOR
OTCOR
PLENU
PLUGG
FOLLO
UPPSH
LOWSH
AHOMO
INCDD
OTCDD
PLEDD
PLUDD
FOLDD
UPPDD
LOWDD
AHODD
```

Data file [31] .OPEDID.DATA(IDNUMXX)

PERKY package input, nuclide IDs, for 'shutdown margin'

```
 1 949
 2 940
 3 941
 4 942
 5 951
 6 925
 7 926
 8 928
 9   8
10  11
11  26
12  24
13  28
14  42
15  25
16 884
17 894
18   6
19 157
```

```
20  40
21 937
22 939
23 950
24 953
25 962
26 963
27 964
28 965
29 948
30 854
31 814
32 966
33 967
34 968
35 439
36 579
37 580
38 582
39 584
40 591
41 603
42 604
43 605
44 606
45 608
46 600
47 617
48 627
49 628
50 620
51 622
52 631
53 633
54 634
55 644
56 646
57 648
58  82
59  83
60  12
61  39
62 441
63 442
64 443
65 539
66 555
67 105
68 115
69 147
70   1
71   2
72   4
73  13
74  36
75  37
76  74
77  20
78 887
79 897
80 857
81 817
82 889
83 899
84 859
85 819
```

Data file [32] .OPEDID.DATA(CHIMG)

PERKY package input, fission spectrum, for 'shutdown margin'

```
  949
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  940
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  941
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  942
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  951
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  925
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  926
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  928
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  937
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  939
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  950
```

```
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  953
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  962
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  963
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  964
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  965
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
  948
2.75164E-02 1.20304E-01 2.22830E-01 2.34682E-01 1.73023E-01 1.40659E-01
5.36056E-02 1.83258E-02 6.10716E-03 1.99826E-03 6.48725E-04 2.11947E-04
6.87782E-05 2.22527E-05 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
    0
```

Data file [33] .OPEDID.DATA(ZONE#XX)

PERKY package input, material zones, for 'shutdown margin'

```
  0   /* OUTPUT OPTION */
  1    8 INNER CORE
  9   32 OUTER CORE
 33   41 SHIELD 1
 42   45 FOLLOWER
 46   48 SHIELD 2
 49   52 ABSORBER
```

Data file [34] .OPMOSD.DATA(GDI1MBRN)

MOSES input, burn-up , for '3D burn-up'

```
GDI1S - LQ PU40/45%,165%F,4*9.75M.,21P ZRH/8P B4C - 18 GROUPS OPTIMIZED
3D BURNUP - SOC 60/50/50/50% EOC 0% STEP 1  CLEAN CORE  SOC&B-U
&& MODIFIED - 65/50/50/50 & 55/50/50/50 FOR REFUELLING STEPS 1 & 3 SOC
```

```
&& CORE VARIANT  7     IMPROVED AXIAL REFLECTORS  HETEROGENEOUS RODS
&&   --------BORON IFIS=-1-------- 1 MESH PER S/A ----- NON-ZERORODTIME
&&   SIMPLED CHAIN, NO MA CHAIN,  B BURN    (WITH F.P. CAPTURE CORRECT)
CONTROL
    3*1     &&  DIFFUSION CAL. ON
    3*1     &&  BURNUP CAL.    ON
EDIT
   0 4*1 2 19*0 1 4*0      &&  EDIT PROGRAM SETUP
   0 1 3*0 1 3*0 1 20*0    &&  EDIT FUEL MANAGEMENT DATA
   0 0 2 2 1 0 1 0 1 1 0 1 0 1 3 0 0 1 1 0 0 1 3*0 1 0 1 0 0  && DIF CAL
   3*0 1 4*0 1 0 2 5*0 9*0 1 4*0   &&  EDIT BURNUP CAL. DATA

EDITD
&&
&&   DETAILED EDIT FOR DIFF. CAL.
        50*0.0
&&   DETAILED EDIT FOR BURNUP CAL.
        50*0.0
&&   DETAILED EDIT FOR N.D. CAL.
        50*0.0
EOB
&&
&&   ------------------------------------------------------------------
&&
LOADING  1
&&
GEOM
&&      NSYM NLAY NPLN NAZN NGRP  PITCH
         2   18   56   15   7     15.81
&&      AXIAL MESH BY REGION
     10 2 1 2  1 2 3 4 4 3 2 1  1 14 6
&&      REGION WIDTH (CM)
 50.0 7.0 3.0 5.0  3.0 6.0 9.0 2*12.0 9.0 6.0 3.0  2.0 70.0 33.0
&&      === NMES  ( NMES=1:CM, NMES=2:MOD.CM)
&&      NMES NCAL NITR NIIT NITM NBATCH OUTCR RLOSS   DELAY NSMALL
CPARA1   2    0   150   8  1600    0  0  0  0  0  3*0  148.28  1
CPARA2   5.E-5 5.E-4 0.5 1.5 1 0.0 4*0 0.0 0 0.0
EOB
&&
&&   ------------------------------------------------------------------
&&
&&       ASSEMBLY AXIAL INFORMATIONS
AXIAL
&&     NREGZ
  15     6  5  4  3     8*1    4  3  7 &&  INNER FUEL
    50.0 7.0 3.0 5.0  3.0 6.0 9.0 2*12.0 9.0 6.0 3.0  2.0 70.0 33.0
  15     6  5  4  3     8*2    4  3  7 &&  OUTER FUEL
    50.0 7.0 3.0 5.0  3.0 6.0 9.0 2*12.0 9.0 6.0 3.0  2.0 70.0 33.0
   1     6                                          && RADIAL SHIELD
        230.0
   3              8   5     7                      && ROD 0%
              65.0       132.0 33.0
   4     5  8   5     7                            && ROD 60%
        40.0 61.0  96.0       33.0
   4     5   8   5     7                           && ROD 50%
        35.0 60.0 102.0 33.0
  15     6  5  4  3     8*1    4  3  7 &&  INNER FUELNEW
    50.0 7.0 3.0 5.0  3.0 6.0 9.0 2*12.0 9.0 6.0 3.0  2.0 70.0 33.0
  15     6  5  4  3     8*2    4  3  7 &&  OUTER FUELNEW
```

```
    50.0 7.0 3.0 5.0  3.0 6.0 9.0 2*12.0 9.0 6.0 3.0  2.0 70.0 33.0
   4     5  8   5      7                                  && ROD 65%
         45.0 59.0  93.0       33.0
   4     5   8   5      7                                  && ROD 55%
         40.0 58.0  99.0 33.0
EOI
&&    ASSEMBLY GROUP ASSIGNMENT
ASYGROUP
      1  1  1  1    1 IC1    INNER CORE
      1  2  1  2    2 OC1    OUTER CORE
      1  3  1  4    3 SHD    RADIAL SHIELD
      2  4  1  4   -4 R0%    ROD 0%
      2  5  1  4   -5 R60    ROD 60%
      2  6  1  4   -6 R50    ROD 50%
      1  7  1  1    1 IC2    INNER CORE2
      1  8  1  2    2 OC2    OUTER CORE2
      2  9  1  4   -9 R65    ROD 65%
      2 10  1  4  -10 R55    ROD 55%
EOI
&&    MATERIAL ASSIGNMENT
REGION
      1  1  1  1  1 $IC1    INNER CORE
      2  2  1  1  1 $OC1    OUTER CORE
      3  3  1  3  1 $PLN    PLENUM AXIAL
      4  4  1  3  1 $PLG    PLUG AXIAL
      5  5  1  3  1 $FOL    GAP FOLLOWER
      6  6  1  5  1 $URS    UP/RAD SHLD
      7  7  1  3  1 $LSH    LOWER SHIELD
      8  8  1  6  1 $ABS    ROD ABSORBER
EOI
&&
&&    CROSS SECTION AND FISSION SPECTRUM
&&
MICROXS
   1  9  33  2  1  2
   1.499E-1 4.330E-1 4.058E-1 1.086E-2 3.839E-4 0.0 0.0
&&
&&    NUCLIDE INFORMATION
&&
XSNUC
&& CODE  NAME  IFIS  KIND  BCAL KLIB  ATW    EFIS ECAP DECAY
    1  PU239     2     1     0   1  239.05   3.34E-11 0   0
    2  PU240     2     2     0   1  240.05   3.36E-11 0   0
    3  PU241     2     1     0   1  241.06   3.37E-11 0 1.526E-9
    4  PU242     2     3     0   1  242.06   3.38E-11 0   0
    5  AM241     2     3     0   1  241.06   3.36E-11 0   0
    6   U235     1     3     0   1  235.044  3.23E-11 0   0
    7   U236     1     3     0   1  236.05   3.24E-11 0   0
    8   U238     1     2     0   1  238.051  3.31E-11 0   0
    9      O     0     5     0   1   15.999   0       0   0
   10     NA     0     6     0   1   22.990   0       0   0
   11     FE     0     6     0   1   55.847   0       0   0
   12     CR     0     6     0   1   51.996   0       0   0
   13     NI     0     6     0   1   58.70    0       0   0
   14     MO     0     6     0   1   95.94    0       0   0
   15     MN     0     6     0   1   54.938   0       0   0
   18      C     0     7     0   1   12.011   0       0   0
   20     ZR     0     6     0   1   91.224   0       0   0
   21  NP237     0     3     0   1  237.048  3.30E-11 0   0
   22  NP239     0     3     0   1  239.053  3.31E-11 0 3.406E-6
   23  AM242M    0     3     0   1  242.060  3.45E-11 0   0
   24  AM243     0     3     0   1  243.061  3.46E-11 0   0
   25  CM242     0     3     0   1  242.059  3.52E-11 0 4.922E-8
   26  CM243     0     3     0   1  243.060  3.52E-11 0   0
   27  CM244     0     3     0   1  244.063  3.53E-11 0   0
   28  CM245     0     3     0   1  245.066  3.53E-11 0   0
   29  PU238     2     2     0   1  238.05   3.33E-11 0   0
   67   B-10    -1     7     0   1   10.0123  0       0   0
   68   B-11    -1     7     0   1   11.0093  0       0   0
   70   H        0     6     0   1    1.0078  0       0   0
   78  U238-FP  -1     4     0   1  238.051   0       0   0
   79  PU239-FP -1     4     0   1  239.055   0       0   0
   80  U235-FP  -1     4     0   1  235.044   0       0   0
   81  PU241-FP -1     4     0   1  241.057   0       0   0
REACT1
    6    7    2   1.0
    8    1    2   1.0
    1    2    2   1.0
    2    3    2   1.0
    3    4    2   1.0
   29    1    2   1.0
    3    5    1   1.0
   67   68    2   1.0
   78   78    1   1.0
   79   79    1   1.0
   80   80    1   1.0
   81   81    1   1.0
    0
YIELD
   78    8 1.0
   79    1 1.0
   79    2 1.0
   79   29 1.0
   80    6 1.0
   80    7 1.0
   81    3 1.0
   81    4 1.0
   81    5 1.0
&&
&&       ATOM NUMBER DENSITY
&&
ATDEN
&&    FROM GDI1 PENCIL OUTPUT/CITDENS INPUT
&&  ZONE   1
 1.69700E-03 1.07870E-04 0.0         0.0         0.0         8.17870E-06
 0.0         2.68370E-03 8.90360E-03 1.03968E-02 1.17896E-02 3.28651E-03
 2.31220E-03 2.61937E-04 2.74457E-04 2.8469E-04 1.28190E-03 0.0
 0.0         0.0         0.0         0.0         0.0         0.0
 0.0         0.0         3.6474E-04  7.7403E-04   2.17920E-03
 0.0         0.0         0.0         0.0
&&  ZONE   2
 1.90280E-03 1.20950E-04 0.0         0.0         0.0         7.53940E-06
 0.0         2.47390E-03 8.92030E-03 1.03968E-02 1.17896E-02 3.28651E-03
 2.31220E-03 2.61937E-04 2.74457E-04 2.8469E-04 1.28190E-03 0.0
 0.0         0.0         0.0         0.0         0.0         0.0
 0.0         0.0         3.6474E-04  7.7403E-04   2.17920E-03
 0.0         0.0         0.0         0.0
&&  ZONE   3
```

```
   0 0 0 0 0 0 0 0 0
    1.06850E-02   8.52990E-03   2.37770E-03   1.67290E-03
    1.89520E-04   1.98580E-04
   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
&&  ZONE   4
   0 0 0 0 0 0 0 0 0
    1.06850E-02   2.89720E-02   8.06319E-03   5.67310E-03
    6.42709E-04   6.73399E-04
   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
&&  ZONE   5
   0 0 0 0 0 0 0 0 0
    1.99080E-02   5.24169E-03   1.46120E-03   1.02800E-03
    1.16460E-04   1.22020E-04
   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
&&  ZONE   6
   0 0 0 0 0 0 0 0 0
    4.38990E-03   4.50900E-02   1.25690E-02   8.84310E-03
    1.00180E-03   1.04970E-03
   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
&&  ZONE   7
   0 0 0 0 0 0 0 0 0
   6.36540E-03  1.77540E-02  4.94900E-03  3.48200E-03
   3.94460E-04  4.13320E-04  9.24600E-03
   0 0 0 0 0 0 0 0 0                                  7.89610E-03
   2.90880E-02
  0 0 0 0 0
&&  ZONE   8
   0 0 0 0 0 0 0 0 0
   9.32849E-03  1.27380E-02  3.55070E-03  2.49820E-03
   2.83010E-04  2.96540E-04  8.22779E-03
   0 0 0 0 0 0 0 0 0                                  3.04990E-02
   2.41210E-03
  0 0 0 0 0
EOI
&&      === CAUTION ===  REFLECTIVE B.C. IS NOT PERMITTED
&&       0.0 MEANS VACUUM
BOUNDARY
   7*0.0
   7*0.0
   7*0.0
REFUEL
   1   0   296.56
   1   1     1.0
   1   1   296.56
   1   1   296.56
   1   1   296.56
   1   1   296.56
   0   0     0.0
   0   0     0.0
   0   0     0.0
   0   0     0.0
REFMAP
1STCORE
     1  91    1
    92 183    2
   184 273    3
   281 285    3
   298 302    3
   189 193    2
   203 207    2
    32  32    4
    38  38    4
   140 140    4
   152 152    4
     8   8    5
    11  11    5
    35  35    6
    41  41    6
    74  74    6
    77  77    6
    80  80    6
    83  83    6
    86  86    6
    89  89    6
   137 137    6
   143 143    6
   149 149    6
   155 155    6
     0   0    0
2NDCORE
     8   8    4
    11  11    4
    35  35    4
    41  41    4
    74  74    4
    77  77    4
    80  80    4
    83  83    4
    86  86    4
    89  89    4
   137 137    4
   143 143    4
   149 149    4
   155 155    4
     0   0    0
3RDCORE
     1   1    7
     4   4    7
     6   6    7
    14  14    7
    16  16    7
    18  18    7
    20  20    7
    34  34    7
    36  36    7
    40  40    7
    42  42    7
    58  58    7
    60  60    7
    62  62    7
    64  64    7
    66  66    7
    68  68    7
    70  70    7
    72  72    7
    82  82    7
    91  91    7
    94  94    8
```

```
  96  96    8
  98  98    8
 104 104    8
 106 106    8
 108 108    8
 113 113    8
 122 122    8
 124 124    8
 133 133    8
 138 138    8
 142 142    8
 150 150    8
 154 154    8
 159 159    8
 161 161    8
 170 170    8
 172 172    8
 174 174    8
 183 183    8
 190 190    8
 192 192    8
 204 204    8
 206 206    8
   8   8    9
  11  11    9
  35  35    6
  41  41    6
  74  74    6
  77  77    6
  80  80    6
  83  83    6
  86  86    6
  89  89    6
 137 137    6
 143 143    6
 149 149    6
 155 155    6
   0   0    0
4THCORE
   3   3    7
  10  10    7
  13  13    7
  23  23    7
  25  25    7
  27  27    7
  29  29    7
  31  31    7
  45  45    7
  47  47    7
  49  49    7
  51  51    7
  53  53    7
  55  55    7
  57  57    7
  78  78    7
  81  81    7
  87  87    7
  90  90    7
  93  93    8
```

```
 101 101    8
 103 103    8
 111 111    8
 116 116    8
 118 118    8
 120 120    8
 127 127    8
 129 129    8
 131 131    8
 135 135    8
 145 145    8
 147 147    8
 157 157    8
 162 162    8
 164 164    8
 166 166    8
 168 168    8
 175 175    8
 177 177    8
 179 179    8
 181 181    8
 189 189    8
 203 203    8
   8   8    5
  11  11    5
  35  35    6
  41  41    6
  74  74    6
  77  77    6
  80  80    6
  83  83    6
  86  86    6
  89  89    6
 137 137    6
 143 143    6
 149 149    6
 155 155    6
   0   0    0
5THCORE
   5   5    7
   7   7    7
  15  15    7
  17  17    7
  19  19    7
  21  21    7
  33  33    7
  37  37    7
  39  39    7
  43  43    7
  59  59    7
  61  61    7
  63  63    7
  65  65    7
  67  67    7
  69  69    7
  71  71    7
  73  73    7
  75  75    7
  84  84    7
```

```
   92  92    8
  100 100    8
  102 102    8
  110 110    8
  115 115    8
  117 117    8
  119 119    8
  126 126    8
  128 128    8
  130 130    8
  134 134    8
  136 136    8
  144 144    8
  146 146    8
  148 148    8
  156 156    8
  163 163    8
  165 165    8
  167 167    8
  176 176    8
  178 178    8
  180 180    8
  193 193    8
  207 207    8
    8   8    5
   11  11    5
   35  35    6
   41  41    6
   74  74    6
   77  77    6
   80  80    6
   83  83    6
   86  86    6
   89  89    6
  137 137    6
  143 143    6
  149 149    6
  155 155    6
    0   0    0
EOI
PLANT
520.0 380
CRPOS
 && IC1 OC1  RS1   BCR   30%  PCR
    0.0 0.0  0.0   0.0   0.0  0.0  34*0.0
EOB
STEP2  -  CYCLE 1, MOC & B-U TO EOC
RODS 0%
CONTROL
   3*1
   3*1
EOB
LOADING 2
EOB
CRPOS
 && IC1 OC1  RS1   BCR   30%  PCR
    0.0 0.0  0.0   0.0   0.0  0.0  34*0.0
EOB
STEP 3  -  CYCLE 1, EOC (NO BURN)
```

```
   95  95    8
   97  97    8
   99  99    8
  105 105    8
  107 107    8
  109 109    8
  112 112    8
  114 114    8
  121 121    8
  123 123    8
  125 125    8
  132 132    8
  139 139    8
  141 141    8
  151 151    8
  153 153    8
  158 158    8
  160 160    8
  169 169    8
  171 171    8
  173 173    8
  182 182    8
  191 191    8
  205 205    8
    8   8   10
   11  11   10
   35  35    6
   41  41    6
   74  74    6
   77  77    6
   80  80    6
   83  83    6
   86  86    6
   89  89    6
  137 137    6
  143 143    6
  149 149    6
  155 155    6
    0   0    0
6THCORE
    2   2    7
    9   9    7
   12  12    7
   22  22    7
   24  24    7
   26  26    7
   28  28    7
   30  30    7
   44  44    7
   46  46    7
   48  48    7
   50  50    7
   52  52    7
   54  54    7
   56  56    7
   76  76    7
   79  79    7
   85  85    7
   88  88    7
```

```
RODS 0%
CONTROL
   3*1
   3*0
EOB
LOADING 0
CPARA1  2  0  150  3  1600     0  0  0  0  0  3*0   0.0  0
EOB
PLANT
520.0 380
EOB
STEP 4  -  CYCLE 2, REFUEL STEP 1 (3RDCORE)
RODS REVERT TO 65/50/50/50%      SOC & B-U TO MOC
CONTROL
   3*1
   3*1
EOB
LOADING 3
CPARA1  2  0  150  3  1600     0  0  0  0  0  3*0 148.28  1
EOB
PLANT
520.0 380
CRPOS
 && IC1 OC1  RS1   BCR   30%  PCR
    0.0 0.0  0.0   0.0   0.0  0.0  34*0.0
EOB
STEP5  -  CYCLE 2, MOC & B-U TO EOC
RODS 0%
CONTROL
   3*1
   3*1
EOB
LOADING 2
EOB
CRPOS
 && IC1 OC1  RS1   BCR   30%  PCR
    0.0 0.0  0.0   0.0   0.0  0.0  34*0.0
EOB
STEP 6  -  CYCLE 2, EOC (NO BURN)
RODS 0%
CONTROL
   3*1
   3*0
EOB
LOADING 0
CPARA1  2  0  150  3  1600     0  0  0  0  0  3*0   0.0  0
EOB
PLANT
520.0 380
EOB
STEP 7  -  CYCLE 3, REFUEL STEP 2 (4THCORE)
RODS REVERT TO 60/50/50/50%      SOC & B-U TO MOC
CONTROL
   3*1
   3*1
EOB
LOADING 4
CPARA1  2  0  150  3  1600     0  0  0  0  0  3*0 148.28  1
EOB
```



```
PLANT
520.0 380
CRPOS
 && IC1 OC1  RS1   BCR   30%  PCR
    0.0 0.0  0.0   0.0   0.0  0.0  34*0.0
EOB
.....................
REPETITIVE DATA REMOVED
.....................

STEP 27 -  CYCLE 9, EOC (NO BURN)
RODS 0%
CONTROL
   3*1
   3*0
EOB
LOADING 0
CPARA1  2  0  150  3  1600     0  0  0  0  0  3*0   0.0  0
EOB
PLANT
520.0 380
EOB
```

.ARCHTAPE.CNTL(REST30)

ARCHIVE restoration of JCL & data files, from cartridge SNHBU3

```
//POC0B17X JOB (),CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1),
//         NOTIFY=POC0B17
//*
//*        MT    DASD s   hi
//*
//*ROUTE PRINT X
//*
//STEP0056 EXEC PGM=JSDGENER
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=DELAY.DATA,DISP=(OLD,PASS),LABEL=(56,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.DELAY.DATA,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(1,9),RLSE)
/*
//STEP0057 EXEC PGM=JSECOPY
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=OPCITD.DATA,DISP=(OLD,PASS),LABEL=(57,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.OPCITD.DATA,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(4,2,50),RLSE)
/*
//STEP0058 EXEC PGM=JSECOPY
```

```
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=OPDEND.DATA,DISP=(OLD,PASS),LABEL=(58,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.OPDEND.DATA,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(20,5,50),RLSE)
/*
//STEP0059 EXEC PGM=JSECOPY
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=OPEDID.DATA,DISP=(OLD,PASS),LABEL=(59,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.OPEDID.DATA,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(20,1,50),RLSE)
/*
//STEP0060 EXEC PGM=JSECOPY
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=OPFORT.DATA,DISP=(OLD,PASS),LABEL=(60,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.OPFORT.DATA,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(22,4,50),RLSE)
/*
//STEP0061 EXEC PGM=JSECOPY
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=OPJCL.CNTL,DISP=(OLD,PASS),LABEL=(61,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.OPJCL.CNTL,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(36,0,50),RLSE)
/*
//STEP0062 EXEC PGM=JSECOPY
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=OPMOSD.DATA,DISP=(OLD,PASS),LABEL=(62,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.OPMOSD.DATA,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(59,2,50),RLSE)
/*
//STEP0063 EXEC PGM=JSDGENER
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=TSS.CLIST,DISP=(OLD,PASS),LABEL=(63,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.TSS.CLIST,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(1,0),RLSE)
/*
//STEP0064 EXEC PGM=JSECOPY
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=TSSMAC.CLIST,DISP=(OLD,PASS),LABEL=(64,SL),
//         VOL=SER=SNHBU3,UNIT=CMTO,DCB=DEN=4
//SYSUT2   DD DSN=POC0B17.TSSMAC.CLIST,
//         DISP=(,CATLG),UNIT=SYSDA,SPACE=(TRK,(11,0,50),RLSE)
/*
//
```

REFERENCES

1 M.Nakagawa, K.Tsuchihashi SLAROM: A code for cell homogenization calculation of fast rector JAERI 1294

2 T.B.Fowler et al Nuclear reactor core analysis code: CITATION ORNL-TM-2496, Rev 2

3 S.N.Hunter EDSLA: an input editing program for SLAROM (to be published)

4 S.N.Hunter A generalized version of the mass balance program MASSN (to be published)

5 S.Iijima, H.Yoshida, H.Sakuragi Calculation program for fast reactor design, 2 (Multi-dimensional perturbation theory code based on diffusion approximation: PERKY) JAERI-M 6993

6 D.Saphier et al Evaluated delayed neutron spectra and their importance in reactor calculations NSE 62 770

7 S.N.Hunter EDMOS: an input editing program for MOSES (to be published)

8 S.N.Hunter. Pu vector sensitivity study for a Pu burning fast reactor PNC TN9410 96-011

9 S.N.Hunter Pu vector sensitivity study for a Pu burning fast reactor Part II: rod worth assessment and design optimization PNC TN9410 97-057

10 H.Hayashi et al Progress report of the design study on a large scale reactor - design study on a 600 MWe class plant PNC TN9410 92-137